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THE AMERICAN
JOURNAL OF PSYCHOLOGY
Founded in 1887
by
G. Stanley Hall

Vol. XXXII JANUARY, 1921 No. 1

THE AMERICAN JOURNAL OF PSYCHOLOGY

Thirty-four years ago, in November, 1887, I falteringly issued the first number of The American Journal of Psychology. There was then no other periodical on this subject in the English language except *Mind*, which was established in 1876 by Croom Robertson, who had told me the interesting story of its inception in a way that filled me with emulation. *Mind* represented advanced British thought, although it had printed not a few of my own articles and those of my students before we had an organ of our own. Both its spirit and its field were very different from the journal I intended, which I wanted to have, first of all, an exponent of experimental laboratory psychology. As, however, there was then no such laboratory in the country save my own at the Hopkins, the supply of material for the six hundred pages per annum that our prospectus had announced was very meager. This was fortunate for the *Journal;* for we had to make a virtue of necessity and include non-experimental articles over a wide range, drawing upon the fields of philosophy, logic, aesthetics, and religious, educational, pathological and comparative psychology. Even thus the supply of acceptable materials was scanty. Hence a very large part of the early volumes was devoted to book-reviews, excluding none of these fields. The vast majority of this small-type material was written by my-

Printed in Germany

self, and this required diligent and almost incessant reading and epitomizing.

Moreover, the *Journal* was a personal enterprise, and for years it was a heavy drain upon my own purse. My hopes and expectations had been extravagant, as I realized to my grief. Subscribers were few, and while there were some cordial expressions of appreciation, *e.g.* from James and Ladd, there was plenty of criticism from conservative instructors in this general field like Dr. McCosh, who felt that the position he had taken in his psychology, that mind and body were utterly disparate and incommensurable, was challenged in our prospectus. The negative attitude of the *Journal* toward telepathy and the English psychic researchers lost us not a few subscribers and alienated a patron who had made a generous and unsolicited contribution—the only one the *Journal* ever had—on the assumption, as it afterwards appeared, that the *Journal* would favor this cult. Thus the second year saw an actual reduction of our subscription list, and only with the third volume did we find our own; and most of the subscribers to that volume are with us yet. Thus for years I was editor, publisher, chief contributor, and sole financial support of the *Journal,* in which at its darkest period I had sunk over eight thousand dollars of my own meager savings, which I saw little prospect of ever regaining. But I was committed to the enterprise and must "carry on." And in this I was encouraged, first by the spirit of Hopkins, and later by the generosity of Jonas G. Clark, our Founder, who employed Dr. Sanford to edit the *Journal* during 1888-89, when I was abroad. With the growth of departments of psychology in the country, and after the organization of The American Psychological Association at Clark in 1890, the fortunes of the *Journal* began to improve, and they have done so slowly and surely ever since.

The chief good fortune in the history of the *Journal* was the advent of E. B. Titchener of Cornell as one of the associate editors in 1895, and gradually the contributions from him, his laboratory, and his pupils have taken the predominant place in its pages. In all the vicissitudes of the *Journal* he

has stood loyally by, and but for his coöperation the *Journal* would have had a far different and less useful and honorable career. New journals have appeared, several of which at first seemed likely to interfere with our circulation, but the record shows that that of the *American Journal* has steadily increased.

In transferring the control of the *Journal,* as I do with this number, to its new editor, I feel, as is only natural, that to part with the child that has occupied so much of my care for so long marks a break which is less only than retiring from Clark, which is only slightly younger than it. Professor Titchener is, however, my natural successor and heir, the only one to whom it ought to go, and under whose management I am rejoiced to feel that the *Journal* will enter upon a new era. I believe that he will not only realize many hopes of my own that I have not been able to bring to fulfillment, but will make the *Journal* a leader and a light as it has never been before. I have asked and received no assurances from him regarding the fate of any of "my policies," so that he is absolutely free to do and make what he will of the *Journal.* But I know something of his ideals, and they have not only my most enthusiastic endorsement, but I bespeak for him all the goodwill and support both from contributors and subscribers that the *Journal* has previously enjoyed, and am confident that under his guidance it will enter upon a larger career of service than it has hitherto known. On the day Clark University opened, the University of Berlin cabled us its *Vivat, Crescat, Floreat.* This is my message to my successor.

G. STANLEY HALL.

The most welcome announcement that I can make to readers of the *Journal* is, I am sure, this: that Dr. Hall does not wholly sever his connection with us, but on the contrary promises us his active sympathy and support. I wish we could make him realize how much this means to us!

As for policies, I did not know that he professed any,—unless, indeed, a wide interpretation of the word 'psychology,' a generous catholicity of attitude toward every movement that

touched psychology and might help to advance it, an eager and yet discriminating enthusiasm for new psychological trends, and a steady adherence to the ideals and standards of scientific work, may be said to constitute policies. I shall, at all events, try in these regards to follow as closely as I many in Dr. Hall's footsteps. We cannot improve upon those early volumes of which he speaks so modestly; but I hope, with the valued aid of my co-workers, to make the future *Journal* worthy of the past.

E. B. TITCHENER.

EARLY PSYCHOLOGICAL THEORIES OF HERBERT SPENCER

By George Bion Denton
Northwestern University

The mature views of Herbert Spencer upon the science of psychology were conceived somewhat under the influence of British philosophy and more under the influence of Biological Evolution. But earlier, he held views representing, in the main, a quite different development. Though the British philosophy was already present, the evolutionary thinking was replaced by a heterodox phrenology. These earlier views might, perhaps, be disregarded—as Spencer himself disregarded them in his *Principles of Psychology*—if it were not that they "adumbrated" (as he might have said) theories which have been developed—and supposedly have been originated—within recent years. Presenting crude notions of Fatigue and of Attention, they constitute a real, though isolated, chapter in the history of modern psychology.

The later psychological views of Spencer were, of course, developed at length in his *Principles of Psychology*, published in 1855; his earlier views, in their completest form, furnished the basis of psychological theory for the essay *The Philosophy of Style*. It may seem remarkable that these two works, representing radically different points of view, should have been published within three years of each other; and the difficulty is increased by the fact that Spencer's letters of the spring of 1852 show that by that time he had already planned his *Psychology* and was at work upon it.[1] The difficulty is removed by the hypothesis that *The Philosophy of Style*, being a revision of an essay, *Force of Expression*, written

[1] *Autobiography*, I, 452-454.

about 1844,[2] differed very little in substance from the earlier essay, except in an added paragraph at the close designed to give the essay an evolutionary turn.[3]

At the age of eleven or twelve, Spencer became a believer in phrenology, and continued such for many years.[4] In time, however, his views ceased to be in strict accord with the leaders of phrenological theory,[5] and the three articles[6] which Spencer published in the *Zoist,* a phrenological journal, in 1843 and 1844, were all heretical. Early in 1846 Spencer devised a Cephalograph, an instrument for making accurate measurements of skulls. Before executing a workable instrument of this design, he became entirely skeptical of phrenology,[7] and his interests turned to other schools of psychology. The *Principles of Psychology,* when it appeared in 1855, was, on the whole, opposed rather than inclined to phrenology, and a passage of several paragraphs[8] was devoted to a judicious criticism of phrenology as a system and to a denial of some of its leading positions.

In *The Philosophy of Style,* Spencer did not attempt to set forth a complete system of psychology, phrenological or otherwise, but attempted to expound only such principles of mental operation as would explain the effective use of language in discourse. Three features of this psychology are especially interesting—the implied theories of the Faculties, of Fatigue, and of Attention.

The Faculties

By such expressions as "every faculty"[9] and "group of faculties,"[10] in *The Philosophy of Style,* Spencer implied that the faculties were numerous. He named several, such as the "faculty of reverence"[11] and the faculty of "approbation."[12]

These faculties, he apparently regarded, not merely as

[2] *Ibid.,* I, 258; 468-469; *Life and Letters,* I, 86.
[3] The proof of this hypothesis the writer has undertaken in a separate study.
[4] *Autobiography,* I, 227-231.
[5] *Ibid.,* I, 261, 282; *Life and Letters,* II, 310.
[6] "A New View of the Functions of Imitation and Benevolence," *Zoist,* I (1843); "On the Situation of the Organ of Amativeness," and "A Theory concerning the Organ of Wonder," *Zoist,* II (1844).
[7] *Autobiography,* I, 634.
[8] Part IV, ch. 8, 606-611.
[9] *Westminster Review,* 58 (1852), 446.
[10] *Ibid.,* 455.
[11] *Ibid.,* 456.
[12] *Ibid.,* 456.

subjective entitles, modes of operation of the mind, but as physiological organs. His theory of fatigue, which will be dealt with in the next section, is evidence of their physiological nature.

The faculties were roughly classified. " . . . In the reflective faculties," he wrote, " in the imagination, in the perceptions of the beautiful, the ludicrous, the sublime, in the sentiments, the instincts, in all the mental powers, however we may classify them . . . . "[13] Apparently this was not meant for a systematic classification, but it seems possible to distinguish three or four groups, such as " reflective faculties," " sentiments," " instincts," and possibly " perceptions." Spencer frequently spoke of " perceptive faculties,"[14] at other places in the essay.

Nothing comparable to these minute and numerous faculties suggested in *The Philosophy of Style* appeared in the *Psychology*. In the latter work, the structural elements of mind were the same as those of the British sensationists. The aspects of Intelligence which Spencer treated were Reflex Action, Instinct, Memory, Reason, the Feelings, the Will,[15] and none of these (as he carefully pointed out) is distinct from another.[16] In the *Psychology* his chief criticism of phrenology was that it made too sharp the demarcation of the faculties.[17] On the contrary, in *The Philosophy of Style* it is the distinctness and the unalterable character of the individual faculty that explains the effect of such devices as Antithesis, Climax, and Anticlimax. " The opposition of two thoughts that are the reverse of each other in some prominent trait insures an impressive effect; and does this by giving a momentary relaxation to the faculties addressed."[18]

This feature of Spencer's early psychology was equally unlike anything held by the British philosophers. The latter, though differing considerably among themselves in regard to the number of faculties, usually conceived a three to five-fold division, comprising such general faculties as Intellect, Emotion, Will. Moreover, none of the British philosophers, not even Hartley, associated the faculties with distinct organs of the brain.

When compared with the faculties as conceived by phrenologists, however, the faculties as represented in *The*

[13] *Ibid.*, 455.
[14] *Ibid.*, 454.
[15] *Principles of Psychology*, Part IV, chs. IV-IX.
[16] *Ibid.*, 584.
[17] *Ibid.*, 609.
[18] *Westminster Review*, 58 (1852), 456.

Philosophy of Style were (it is hardly necessary to show) very similar to those of phrenology; and such phrenological names as "reverence," "ideality," and "approbativenes,"[19] for example, corresponded to Spencer's "reverence," "beauty," and "approbation."[20] The phrenological faculties, too, like Spencer's, were distinct, physical, and anatomically localized.[21] Similarity in the classification of the faculties may also be noticed, for Spurzheim divided them into Intellectual and Affective, with subdivisions of Reflective and Perceptive under the first head, and Sentiments and Propensities under the second.[22]

Fatigue

Spencer's theory of fatigue, stated most definitely in the latter part of the essay, was implied throughout. In the third paragraph, explaining the general principle of economy of attention in the use of language, Spencer wrote: "A reader or listener has at each moment but a limited amount of mental power available. To recognize and interpret the symbols presented to him requires part of this power: to arrange and combine the images suggested requires a further part; and only that part which remains can be used for the realization of the thought conveyed."

Later, a more explicit statement was made: "Without going at length into so wide a topic as the exercise of faculties and its reactive effects, it will be sufficient here to call to mind that every faculty (when in a state of normal activity) is most capable at the outset; and that the change in its condition, which ends in what we term exhaustion, begins simultaneously with its exercise. This generalization, with which we are all familiar in our bodily experiences, and which our daily language recognizes as true of the mind as a whole, is equally true of each mental power, from the simplest of the senses to the most complex of the sentiments. If we hold a flower to the nose for long, we become insensible to its scent. We say of a very brilliant flash of lightning that it blinds us; which means that our eyes have for a time lost their ability to appreciate light. After eating a quantity of honey, we are apt to think our tea is without sugar. The phrase 'a deafening roar,' implies that men find a very loud sound temporarily incapacitates them from hearing faint ones. Now, the truth

[19] Spurzheim, *Phrenology*, 225-228; 243-245; 212-214.
[20] *Westminster Review*, 58 (1852), 456.
[21] Spurzheim, *Phrenology*, 90-98.
[22] *Ibid.*, 149-151.

at once recognized in these, its extreme manifestations, may be traced throughout; and it may be shown that . . . . in all the mental powers . . . . action exhausts; and that in proportion as the action is violent, the subsequent prostration is great."[23]

Discussions of fatigue as a factor in mental phenomena are common enough in the psychologies of today, but in 1852 and before one would have looked for them in vain in the works of British psychologists and philosophers. Some phases of Spencer's own biological view of psychology set forth in the *Psychology* would have accommodated his earlier theory of fatigue, but nothing of the sort appeared in that work.

Phrenologists, however, made considerable use of the idea of fatigue. "The faculties of animal life," wrote Spurzheim, "cannot act incessantly, they require repose. Study of the same subject, too long protracted, causes fatigue; by changing this we may still continue our labors. Now if the brain were a single organ, that performed all the functions of the mind, why should it not be still further fatigued by this new species of action? Although our eyes be fatigued by looking at pictures, we can still listen to music, because there is a particular organ for each of these sorts of impressions."[24] "As during watching the same organ is not always active, but reposes at intervals; so, during sleep, all the organs do not sink into inactivity together, but a particular one continues its function, and then the peculiar state called dreaming supervenes. . . . Every corporeal organ being fatigued takes rest, and this state of rest is sleep; but single, or even several organs, may be active while the others repose."[25]

Attention

Attention is the most interesting of Spencer's early psychological conceptions. In the first part of the essay (consisting of fifty paragraphs) attention was the most comprehensive power of intellect, and its economy was represented as the great desideratum in the use of language.

In several respects, attention, as Spencer conceived it, had features in common with attention as it is generally regarded by psychologists today.

On the subjective side, the result of attention upon the idea seems to be to increase the effectiveness of the idea.

[23] *Westminster Review*, 58 (1852), 437.
[24] Spurzheim, *Phrenology*, 95.
[25] *Ibid.*, 96.

Spencer used commonly the terms "vivid,"[26] "forcible,"[27] and "effective"[28] to denote the influence of attention upon the content of mind. Other subjective features, such as the "selective" function of attention and its effect upon retention in memory, scarcely arose for consideration.

The physiological character of Spencer's view of attention is most noteworthy. Attention is apparently a reservoir of physical energy at the service of mental life. Every mental act of any sort requires attention; it uses up energy. The energy of attention is associated with the activity of the whole mind, or rather with every part of it. It is a fixed amount—"A reader or listener has at each moment but a limited amount of mental power available"[29]—and it may be temporarily drained to varying degrees of fatigue or exhaustion. The attention is "absorbed"[30] or "frittered away,"[31] or there is a "strain upon the attention."[32] Moreover, it may be drained through many channels; that is, it is applicable to the needs of any faculty. Finally, attention reenforces the activity of specialized portions of the brain; and apparently this physiological reenforcement corresponds to the mental effectiveness produced by attention. Attention may be taxed by severe demands upon one faculty or by multitudinous demands upon many faculties simultaneously. In one place Spencer began, ". . . If some subtlety in the argument absorb the attention—if every faculty be strained in endeavoring to catch the speaker's or writer's drift—"[33] Very clearly "straining every faculty" is the same as "absorbing the attention;" and indicates as clearly as may be in brief the relation of attention and faculties, explained above.

Dominant as attention was in *The Philosophy of Style,* it did not appear again as a psychological entity of importance in Spencer's works. In *The Philosophy of Style,* the word "attention" appeared seventeen times in fifty paragraphs.[34] In *Principles of Psychology,* the word appeared twenty times in six hundred and twenty pages. Six[35] of these latter

[26] *Westminster Review,* 58 (1852), 439.
[27] *Ibid.,* 440.
[28] *Ibid.,* 451.
[29] *Ibid.,* 437.
[30] *Ibid.,* 438.
[31] *Ibid.,* 451.
[32] *Ibid.,* 454.
[33] *Ibid.,* 446.
[34] *Ibid.,* 436, 437 (three times), 438 (twice), 439, 440, 443, 446, 449 (twice), 451, 454 (four times).
[35] *Principles of Psychology,* 122, 127, 209, 363, 449, 616.

instances had no psychological significance, and none of the others[36] indicated anything like a theory of attention.

Whence could the suggestion for his theory of attention have come? Modern writers upon psychology assert that the British thinkers did not study attention, as it is conceived today. "With some notable exceptions (Wolff, Kant, and James Mill) the attention was greatly neglected until more modern times, notably by the English empiricists. . . . It was considered an unanalysable attribute of the soul, and direct evidence of the independent activity of the mental principle (Hamilton, Carpenter, McCosh)."[37] Professor James wrote: "Strange to say so patent a fact as the perpetual presence of selective attention has received hardly any notice from psychologists of the English empiricist school. The Germans have explicity treated of it, either as a faculty or as a resultant, but in the pages of such writers as Locke, Hume, Hartley, Mill, and Spencer the word hardly occurs, or if it does, it is parenthetically and as if by inadvertence."[38]

Such writers, British and Continental, as may have treated of attention were probably all unknown to Spencer. He was never well read in philosophy, and the little that he knew by 1852 was mostly second hand. His own statements[39] in regard to his philosophical reading would make certain that no suggestion for his conception of attention could have been derived from the philosophers.

Attention was certainly not a fundamental and characteristic conception of phrenology; yet it was a conception that the phrenologists were constantly meeting on the Continent. Such conceptions as Memory, Association, and Will, Spurzheim did not directly attack, but reinterpreted in harmony with phrenology. Similarly, with attention. He wrote: "The word *attention* denotes no more than the active state of any intellectual faculty; or, in other terms, attention is the effect of the intellectual faculties, acting either from their proper force, or from being excited by external impressions, or by one or several affective faculties. Hence there are as many species of attention as fundamental faculties of the mind. . . . It is, indeed, absurd to expect success in an art or science, when the individual power on which its comprehen-

[36] *Ibid.*, 194, 195, 235, 281, 282, 299, 315, 477, 495, 503, 546.
[37] Baldwin, *Dictionary of Philosophy and Psychology*, article on "Attention."
[38] James, *Principles of Psychology*, I, 402.
[39] *Life and Letters*, I, 145-147.

sion depends is inactive. Again, the more active the power is, the more it is attentive."[40]

Coupled with the phrenological view of physiological exhaustion of the faculties, this doctrine would hold that attention is the state of greatest physiological activity of an "organ" of the brain; and the greater the task of the organs or faculties, the greater the exhaustion of the attention. There was much in this phrenological view that is like Spencer's theory in *The Philosophy of Style*.

The conception of attention which Spurzheim was forced grudgingly to admit existed as a mental phenomenon of secondary importance, Spencer, the phrenological heretic, might well have welcomed as a fundamental organ of mind. Certain features of Spencer's article, "A Theory concerning the Organ of Wonder," published in the *Zoist* in 1844, point to such a view.

Spencer there proposed that what was commonly regarded by phrenologists as the Organ of Wonder was in truth an organ whose main function is to recall impressions once received.[41] This theory was proposed by Spencer as supplementary to an article of the previous year, entitled "*Imitation and Benevolence*."[42] In that article he reinterpreted the Organ of Imitation into an organ whose function was to excite sympathetic states of mind, while the Organ of Benevolence became "the grand centre of sensation, and is excited by the affections of all the other organs."[43] The names for the three organs, Wonder, Imitation, and Benevolence, became then Revivisence, Sympathy, and Sensitiveness, respectively. The whole theory was summed up as follows, in the later article: "It was maintained that it is the primary office of the organ entitled Imitation, to excite in the mind of one being the feelings exhibited in another, and it is the aim of the present essay to show that the true duty of the adjoining organ, hitherto called Wonder, is the revival of intellectual perceptions. It is the object of both to bring certain other faculties into activity. By the one, feelings are recalled; by the other, impressions."[44]

The next to the last sentence is to be noted: Revivisence acts as a reenforcement of the intellectual faculties. In this respect, although applied to the service of memory only, it is

[40] *Phrenology*, 380.
[41] *Zoist*, II (1844), 316-325.
[42] *Zoist*, I (1843).
[43] *Ibid.*, 377.
[44] *Zoist*, II (1844), 322.

like attention in *The Philosophy of Style,* and might have been adapted to the needs of that essay.

Interesting in this connection is the fact that Dr. Bernard Hollander has identified Spencer's Organ of Wonder with the modern conception of attention. Dr. Hollander pointed out that Spencer, by assigning to that organ the function he did assign, anticipated the work of Professor Ferrier in regard to localization of functions in the brain.[45] And this conclusion Dr. Hollander arrived at, apparently, without knowledge of Spencer's use of attention in *The Philosophy of Style.*

Dr. Hollander quoted Ferrier in regard to the function of "area 12," which corresponds to the Organ of Wonder: " . . . the excitation of which causes the eyes to open widely, the pupils to dilate, with movements of the eyeballs and head. It gives the appearance of attention, and the movements indicated are essential to the revivification of ideas."[46]

If, as Dr. Hollander believed, Spencer's Organ of Revivisence anticipated the modern notion of the function of attention and its location in the brain, then it is very likely indeed that, in *The Philosophy of Style,* attention is merely a development and new application of the phrenological theory of revivisence.

That Spencer should have changed the name of attention in the essay on style is easily understood. For one thing, the application to memory was not largely involved in the later essay. For another, Spencer admitted that the name "revivisence" was awkward.[47] Finally, it is probable that in writing for *Westminster Review* (in which the essay on style appeared), Spencer was not desirous of suggesting totally unfamiliar terms, or phrenological terms which might call his psychology in question. He probably adopted the name "attention" because it was used by phrenologists in somewhat the same sense as he employed it, and because he found it occasionally in works on rhetoric[48] from which he borrowed considerably in writing *The Philosophy of Style.*

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[45] *Westminster Review,* 139 (1893), 142-154.

[46] *Ibid.,* 148.

[47] *Zoist,* II (1844), 320.

[48] Spencer quoted from Blair the statement that "long sentences fatigue the reader's attention." See also, Denton, "Herbert Spencer and the Rhetoricians," in *Publications of the Modern Language Association of America,* XXXIV (1919), 89-111.

British Sensationism and Associationism

The presence of phrenology in *The Philosophy of Style* did not preclude the use of British sensationism and associationism in that essay. As has already been said, when the theories of rival systems did not directly conflict, phrenologists were likely to admit their validity as explaining phenomena of secondary importance. The doctrines of the British philosophers explained some points where phrenology was vague or non-committal, and therefore they were sometimes given a qualified acceptance by phrenologists. In opposition to *tabula rasa,* the phrenologists believed that varying developments of the organs of mind produced varying experiences and characters,[49] but this doctrine did not exclude the operation of sensation and association but merely complicated it. Phrenologists admitted that it is through the medium of the external senses "that determinate consciousness of the external world is acquired,"[50] and they made some use of association.[51]

In *The Philosophy of Style* Spencer made use of the two fundamental assumptions of British psychology—sensationism and association. Ideas exist in the mind only in the form of "images." When one starts to think "horse," there "tends to arise," (and when one completes the process, there does arise) "in the mind, a picture answering to the word," and the horse must be black, or brown, or some color at least. What is true in this regard of the more specific ideas is equally true of the most general concepts. "We do not think in generals but in particulars." When we think a class-idea, "we represent it to ourselves by calling to mind individual members of it." Or, in other words, to represent the general idea, the thinker, "has to choose from among his stock of images, one or more, by which he may figure to himself the genus mentioned."[52]

The assumptions of British associational psychology are obvious in many places in *The Philosophy of Style.* Associations were designated as "powerful" or "strong" in proportion to the "ease and rapidity of the suggestive action." An association becomes powerful through repetition.[53]

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[49] Spurzheim, *Phrenology,* Part I, sec. IX, ch. I; secs. IV and VII; Part II, sec. III.

[50] *Ibid.,* Part I, sec. IX, ch. I, 253.

[51] Combe, *A System of Phrenology,* 420; 499-503; Spurzheim, *Phrenology,* Part II, sec. I, 387-388.

[52] *Westminster Review,* 58 (1852), 439.

[53] *Ibid.,* 437-438. When the essay was republished in 1858, Spencer substituted the word "strong" for "powerful."

Perceptions of objects and processes of reasoning were regarded as complex, consisting of concatenations of simple ideas or impressions. The mind, after recognizing and interpreting the bare symbols, is obliged to arrange and combine the suggested images to constitute thoughts.[54] Even in the case of perceiving words, the syllables must be connected by the mind.[55] All thoughts are "built up" according to some natural or customary order of associating their elements; and for that reason, the elements of a sentence must be ordered according to such associations.[56] The force of suggestion depends upon association, for "each of the facts mentioned presupposing numerous others, calls up these with more or less distinctness, and revives the feeling . . . . with which they are connected in our experience."[57]

That Spencer was familiar with the terms and positions of British psychologists, at least to the extent shown in *The Philosophy of Style*, is evidenced in his writings known certainly to be of early date.[58] The source of his knowledge was probably not the British philosophers themselves. Much more likely, he took his doctrine second hand from the works of two rhetoricians, consulted in the preparation of the essay on style. Lord Kaimes' *Elements of Criticism*[59] and George Campbell's *Philosophy of Rhetoric*[60] contained accounts of British psychology sufficient to supply Spencer with all the knowledge he needed for his essay.

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[54] *Ibid.*, 436.
[55] *Ibid.*, 438.
[56] *Ibid.*, 439.
[57] *Ibid.*, 451.
[58] The terms are to be found here and there in "A Theory concerning the Organ of Wonder," in "Imitation and Benevolence," in the preface to his father's *Lucid Shorthand*.
[59] Ch. XVIII, sec. 2; also Appendix of Terms Defined, paragraphs 41 to 44.
[60] Bk. I, ch. V, part ii; ch. VII, sec. iii; Bk. II, ch. VII, sec. i.

THE COMPARATIVE INFLUENCE OF MAJORITY AND EXPERT OPINION

By Henry T. Moore, Dartmouth College

The literature on Social Psychology contains numerous references to the influence of the group on the opinions of the individual. This one point has been made the subject of practically an entire volume by Trotter,[1] who refers to group opinion somewhat picturesquely as the voice of the herd. He represents this voice as coming with such a weight of authority that even the most eccentric individual feels compelled to seek some form of herd support for his opinions, and is completely at a loss when no such support is anywhere to be had.

The general fact is beyond dispute, but those who would like to see Social Psychology multiply its experimental findings are tempted to ask more specifically just how great this influence may be expected to be in any given situation. Can we hope to measure it? And if so, how does it compare with other influences that are likely to operate in determining an individual's social attitudes?

The group experiment here reported attempts a beginning at answering these questions for three types of situation,—namely, speech, morals, and music. The method is somewhat similar to one used by Bridges[2] in a study of decision types reported in 1914. In general it consists of measuring a suggestive influence in terms of the number of reversals of judgment occasioned by it, as compared with the number that might have been expected by chance. The first problem was therefore to find out what was the chance of reversal of judgment in regard to each of the three kinds of material used. Ninety-five subjects were given eighteen paired comparisons for each of the three types of situation. The instructions for the linguistic judgments were that the subjects check the more offensive one of each pair of expressions. Examples of the expressions compared are: "Everybody loves

[1] Trotter, W., The Instincts of the Herd in Peace and War, 1916.

[2] Bridges, J. W., An Experimental Study of Decision Types and their Mental Correlates, *Psych. Rev. Mon. Sup.*, 1914, Vol. XVII, No. 1.

their mother." "She sort of avoided him." "The party that wrote that was a scholar." "He never studies nights." The ethical judgments involved the checking of the more offensive of two traits of character in each of the eighteen pairs. Examples of the traits compared are:—disloyalty to friends; willingness to get rich by questionable financial methods; cheating on an examination; willingness to overlook a business error favorable to oneself. The musical judgments involved an expression of preference for one of two resolutions of the dominant seventh chord, played on a reed organ. Eighteen paired resolutions were played, and the preferences recorded after each.

Two days later the same three series were repeated exactly as given before, and without the introduction of any special suggestive influence to alter the original judgments. Each subject was now scored on the basis of his percentage of reversals, and the mean of the ninety-five individual scores was taken as the chance of reversal for judgments concerned with that particular type of material. The average score thus recorded as representing the chance of reversal for linguistic judgments was 13.5 per cent with .55 P. E. of the mean; for moral judgments 10.3 per cent with P. E. of .50; for musical judgments 25.1 per cent, with P. E. of .84. These results are indicated graphically in the upper accompanying chart.

As a partial check on the above figures each of the three series of judgments was tried on a different group. The subjects in the check experiment were on an average about a year older than those in the original experiment, which probably accounts for their slightly lower per cent of reversals. Forty-three subjects gave 11.4 per cent chance of reversal in linguistic judgments; 62 subjects gave 9.4 per cent reversals in ethical judgments; and 49 subjects gave 22.6 per cent reversals in musical judgments.

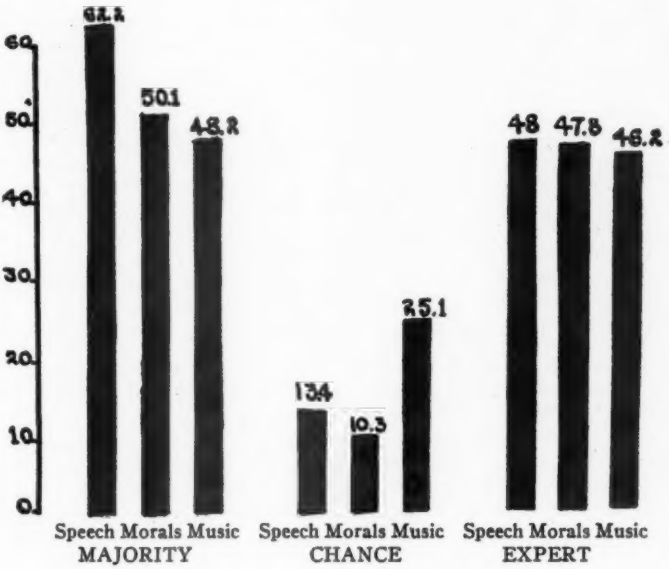
An interval of two and a half months was allowed between the experiment without suggestion and that in which suggestion was used. This seemed ample time to render negligible any memory effects from the preceding judgments. The experiment was now repeated as before, except for the addition of the suggestive influences. A new set of original judgments was taken, and after a two day interval the subjects were given the same series again, this time with the statement of what had been the majority preference for each pair. Great care was taken to convince them that these statements were being truthfully made, and the influence of suspicion was certainly

not great. Each subject was now scored on the basis of the per cent of opportunities he had accepted to reverse his judgment so as to agree with majority opinion. The results are indicated in the three left columns of the upper chart. The average of such reversals in linguistic judgments was 62.2 per cent, with P. E. of 1.63; in ethical judgments 50.1 per cent, with P. E. of 1.69; in musical judgments 48.2 per cent, with P. E. of 1.52.

Two days later still the same comparisons were repeated, and at this time each judgment was preceded by a statement of the opinion of an expert in each field. These statements in some cases coincided with what had been given as majority opinion previously, but as often as not they were at variance with it. From these last records each individual was scored on the basis of the per cent of opportunities he had accepted for reversing his original judgment favorably to the statement of the expert. The results, which are indicated in the three right columns of the upper chart, show an average of 48 per cent reversals of language judgments, with P. E. of 1.4; 47.8 per cent reversals of ethical judgments, with P. E. of 1.6; and 46.2 per cent reversals in musical judgments, with P. E. of .9.

If now we take as our unit of measurement the per cent recorded as the chance of reversal, we find, as indicated on the lower chart, that the probability of reversing favorably to the majority in matters of speech and morals is approximately five times chance; whereas in matters of musical feeling the probability is only about twice chance. By majority is meant here of course only the special type of majority provided in the experiment, but if generalization is permissible on the basis of the evidence available, we may venture the statement that a man is two and a half times as individualistic in his musical likes and dislikes as in his moral and linguistic preferences. Similarly we may conclude that expert and majority opinion hold about equal sway over the individual in morals and music, but that the chances are about ten to seven in favor of majority prestige in matters pertaining to speech. To take a concrete case, the struggle between the expert pronunciation which accents the word 'cantonment' on the first syllable, and the army pronunciation, which accents it on the second syllable, is likely to end with the doom of the expert, whereas classical music has at least an even chance in its struggle with the popularity of the jazz band.

The type of experiment here described can, on account of the great range of individual variations involved, be valid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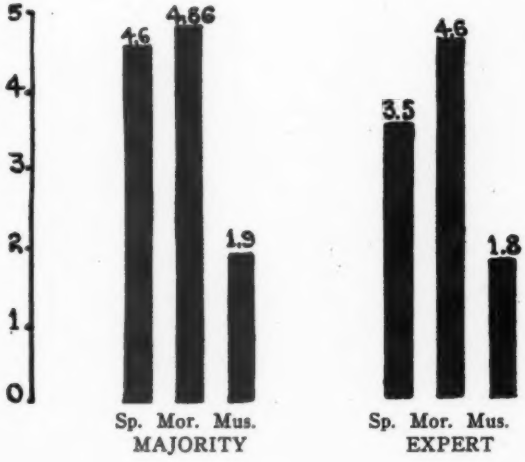
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only if applied to a large number of cases; and inasmuch as each particular experiment measures only a very particular type of suggestibility, any generalization from a single experiment will always be questionable. But it is believed that an extension of the method to cover a large number of typical cases in which such social influences as personal prestige, fashion, orthodoxy, etc., play a part, would give material which would be valid for general purposes. Whether the shrunken prestige of a defeated political candidate or of an abdicated emperor follows any accurately describable laws, one could scarcely venture to say; but it is sufficiently obvious that until so-called social laws rest on more than the personal observations of individual writers, we shall have a great excess of laws, and only a minimum of confidence in applying them.[3]

[3] Read at the Annual Meeting of the American Psychological Association, Cambridge, Mass., Dec. 31, 1919.

THE NUMBER FORMS OF A BLIND SUBJECT

By Raymond H. Wheeler and Thomas D. Cutsforth

Number forms in the adventitious blind are sufficiently rare to warrant the description of a case. The reagent whose forms are here described is T. D. C., one of the authors of this article and a former major student in psychology at the University of Oregon. On March 9, 1917, detailed descriptions, in writing, of these forms were obtained and filed away. On August 15, 1919 the reagent was unexpectedly asked to describe these forms again. These latter descriptions were then compared in minute detail with the earlier descriptions.

The reagent has a simple digit form for the numbers 1—10, a tens form for the numbers 10—100, a hundreds form for the numbers 100—1,000, a thousands form and so on into the millions. He also has a week form, an alphabet form, a month form and a century or date form. He also has numerous varieties of synaesthesia.

The lower right hand figure in the accompanying cut is the reagent's form for the numbers 1—10. Each rectangular section is sharply differentiated from its neighbor by means of hue and brightness qualities which stand for separate numbers. The numbers themselves are never visualized and when the subject uses this form he translates the colors into numbers vocal-motor fashion. The form appears in space in front of the reagent's face at a distance of about one meter. The entire form is about fourteen centimeters long and two centimeters in width. The following are the colors for the numbers 1—9, taken verbatim from introspections.

	On March 9, 1917	On August 15, 1919
1.	white	whitish, nothing but brightness
2.	dull grey, tinged with yellow, like old weather beaten boards	grey, slightly yellow, like old weathered straw
3.	like 2 but more reddish	light, faint reddish brown
4.	like 3 but darker	peculiar brown, like fir boards

5. muddy black	a dull black, like spilled ink
6. white, like 1, identified by position	white, like ivory
7. dark, muddy blue	bluish black, somewhat like graphite, but darker
8. grey, tinged with yellow	very poorly saturated yellow
9. dull grey tinged with yellowish green	dark grey with greenish cast; a bottle green

The tens form consists of ten of the small digits forms placed end to end in a direction upward and away from the reagent toward the right, beginning at a point in front of his left shoulder. Each of the smaller unit forms represents figures from 1—9, 10—19, 20—29 etc. The extreme right end of the form bends more sharply away from the subject and upward less abruptly enabling him to visualize the entire form almost at once and to make use of it with less extended eye-movements. With the exception of the numbers from 10—19 each intermediate figure in the various ranges of tens is colored according to the final digit.

The hundreds form is a product of tens forms. The colors are determined in similar fashion. The thousands form is a product of hundreds forms and so on. In all of these latter forms the colors represent ranges and not individual numbers. For example in the hundreds form there are ten colors, representing the ten ranges of ten numbers each. In the thousands form there are ten colors representing ten ranges each of 100. When the reagent thinks of large numbers several forms are used and held in consciousness at the same time, the smallest form in the foreground and the larger forms localized back of the first one in order of their size. This can best be understood by reference to an analogy. Let each form be represented by a framed picture. The several forms in use at one time would then be represented by a series of framed pictures set up one behind the other, each one larger than the one in front of it and resting on a higher level. The individual forms retain their identity by their localization and by a colored halo which latter varies with each form. The halo would be represented by the frame of the picture. The halo or background for the hundreds form is black; for the thousands form it is silvery white; for the hundreds-thousands form it is reddish-brown and for the millions form it is yellow.

The following illustrates how the forms are used. When the reagent thinks of the number 3,591 a thousands form

appears in the background of a visualized field, with the appropriate section in the focus of attention, namely, the third section from the left hand end. Directly in front of this lies the hundreds form and with a "slide rule" effect the reagent's line of regard shifts to the fifth section of this latter form. A second shift of his line of regard brings the reagent's attention to the ninth section of the tens form which latter lies slightly below and in front of the hundreds form. A final shift carries his regard to the first section of the digits form which lies at the left hand end of the tens form, when thinking of large figures. The rapid use of number forms has been described several times in the literature. Diamandi's success as a lightning calculator was in part due to the use of a number form.[1] In the present case this fact is all the more remarkable for the reason that the numbers are not visualized. Colors are used as substitutes. Hennig,[2] Grüber,[3] and others have pointed out that in cases of synaesthesia colors have been used to represent numbers in performing mathematical operations. Galton[4] seemed to have been able to substitute odors for mathematical symbols in simple operations of adding and subtracting.

As an example of such a substitution of colors for numbers we give the following instance of counting in terms of colors. The authors were giving mental tests at the Oregon State School for the Blind. The reagent was in the act of counting the number of words which one of the blind pupils was giving within the interval of three minutes. He began by counting the words in vocal-motor fashion but in a short time vocal-motor imagery became confused and he was obliged to cease relying upon inner speech. In the meantime, however, each verbal image had been accompanied by its appropriate color, localized properly in the number forms. From this point on until the end of the three minutes the reagent, who was then acting as examiner, was able to keep track of the number of words which the pupil was reciting to him. The last color was then translated into the appropriate figure.

When the reagent is given large numbers to locate in these forms, eye-movements can be seen as he shifts his line of regard from one form to another or from one part of the

[1] See Philips, Genesis of Number Forms, *Amer. Jour. of Psychol.*, Vol. 8, 1897, 506-527.

[2] Enstehung und Bedeutung der Synopsien, *Zsch. f. Psychol.*, 1896, Vol. 10, 113-122.

[3] L'audition colorée, Cong. inter. Psychol., Paris, 1889.

[4] Arithmetic by Smell, *Psychol. Rev.*, 1894, Vol. 1, 61-62.

same form to another part. The extent of eye-movement is proportional to the size of the forms which are being used. Voluntary or artificial checking of these eye-movements impedes the reagent in the use of the forms.

The upper figure of the cut is a miniature copy of the reagent's week form. Each day of the week is represented by a colored section in the form. Monday is dark, inky blue; Tuesday is pale brown; Wednesday is a very dark green; Thursday is a dark orange-red; Friday is a "russet" yellow; Saturday is a muddy, curdled black and Sunday is white.

The lower left hand figure is his month form. Again no letters or writing are seen in the form but the months are represented in colors. The flattened portion of the form corresponds to vacation periods of the school year. The subject is unable to recall the conditions under which the form originated.

The long figure in the cut represents the century or date form. It is about four centimeters wide and a meter long. It is visualized upon a globe-map of the world and upon this background appear dark, faintly colored areas as continents and light blue areas as oceans. The dates appear in color, not in figures or in writing. 1900 lies above the eastern coast of the United States; 1066 A. D. lies just above the British Isles; the dividing point between A. D. and B. C. in the region of the Mediterranean Sea and so on. The dates are colored according to their component digits. This form originated when the subject was first studying geography, and is used constantly as an aid in fixing and in recalling dates.

The figures in the cut are photographs of card-board models made by the reagent himself. In the actual forms there are no figures, the figures being inserted merely to explain the forms. The photograph was taken in March, 1917. In August 1919 the reagent made new models of all forms. During this interval of time none of these forms had changed except in minor degrees of saturation or in slants of some of the lines, and these differences may have been due to inaccuracies in making the model or in describing the colors. One exception must be noted, however. The century form originally slanted upward at its extreme right end. In the cut it is seen slanting downward. This change occurred during the time that the reagent was in college, and can be traced to the repeated use of this form while the reagent was studying Babylonian History. Since then the form has resumed its original upward slant.

THE NUMBER FORMS OF A BLIND SUBJECT

SOME PROBLEMS IN REGARD TO ALIMENTARY SENSITIVITY

By Ivy G. Campbell

The observations around which the discussion in this article are centred were made under rather unfavorable experimental conditions and are offered not as conclusive evidence on disputed points but rather as suggesting problems and technique for future investigations.

The writer after several months of "stomach trouble" was put in March 1919 under the care of Dr. Einhorn of N. Y. City, whose very ingenious method of treatment gave her opportunity for the following study. The stomach was given a complete rest for two weeks during which time duodenal feedings were given. This was accomplished by direct feeding into the duodenum by means of a tube which passed from the mouth into the duodenum. This tube was not withdrawn during the two weeks period, but every day—from 6 a. m. to 8 p. m.—at two-hour intervals, from 240-300 c. c. of food (milk, raw egg, sugar of milk, and, toward the end of the treatment, butter) were forced through it into the duodenum. The apparatus which permitted this treatment is described by Dr. Einhorn as follows: "The duodenal pump consists of a small metal capsule (14 mm. long and 23 mm. in circum.) which is perforated and can be unscrewed. This communicates with a long, thin rubber tube (8 mm. in circum. and one metre long), and is marked at 40 (I. cardia), 56 (II. pylorus), 70 (III), and 80 cm. distance from the capsule. At its end is a tip, to which a syringe can be attached." (6:86)

The greatest part of this paper will be devoted to a discussion of hunger, but some observations on and interpretations of appetite, fulness and emptiness, thermal sensitivity, will be given.

Hunger.—The experimental findings of Cannon and Washburn, later verified and extended by Carlson, Boring, and others, have convinced most readers that hunger is a sensation or sensational complex concomitant with the periodic, intermittent contractions of the empty or nearly empty

stomach. Carlson holds that each separate contraction is synchronous with a hunger pang, and that the intensity and duration of the hunger correspond pretty closely with the strength and the duration of the stomach contractions. He also found that his subjects locate the sensation of hunger in the stomach. His data obtained from observations on fasting subjects is of special interest in connection with the observations reported in this paper.

In the case where Carlson and one of his assistants underwent a five day starvation period they found that there was an increase rather than a decrease of the gastric tonus and the hunger contractions during the period (4:128); that the sensation of hunger was almost continuous after the first day of starvation, i.e. it did not wholly disappear during the intervals between the vigorous gastric contractions; and that during the first three days the hunger was greater than during the last two although the contractions were greater in the last two days than on the first three. (4:135) They also found that appetite was increased during the first few days and then decreased so that toward the last there seemed to be indifference toward food "despite the persistent hunger call of the stomach." (4:136) The discrepancy in the parallelism between the intensity of the gastric hunger contractions and the intensity of the subjective hunger sensations was due, Carlson is inclined to believe, to the depression of the Central Nervous System. (4:136) In the case of the man who under Carlson's observation completely fasted for fifteen days and for the subsequent eight days except for the daily injection of a quantity of cotton fibre it was found that the hunger contractions were continuous with practically normal rhythm and intensity but that the subjective sensations appeared to be somewhat weakened, tinged with an element of general epigastric distress or sick stomach. The appetite sense or desire for food was modified or obscured by a tendency to a persistent bad taste in the mouth, yet the dominant element in consciousness was reported to be the thought of food and eating. (5) In the treatment given the present writer the stomach was kept empty—except for one half-wine-glass dose of liquid medicine (bismuth and magnesium) given three times a day—for a period of fourteen days. Despite this continued emptiness, hunger—except in the few cases noted below—was not felt. This result seems at variance with those of Carlson and considered in connection with the manner of her treatment gives rise to a number of questions: (1) Are stomach contractions inhibited by duode-

nal feedings; (2) If not, is it then true that stomach contractions are the most important concomitant physiological factor in hunger; (3) Is it possible, as has been suggested, that intestinal contractions play a large, if not the principal part, in hunger and that duodenal feedings inhibit these but do not inhibit the stomach contractions?

Carlson incidentally raises some of these questions and gives some experimental evidence that helps to answer them. He believes that intestinal contractions do take place during hunger, but that they play a very small part, if any, in the sensation of hunger. The proof of such a part is still wanting (4:83). In regard to question (1) above, Carlson describes some experiments made upon dogs which show that, in this case at least, stomach contractions are reflexly inhibited by stimulation of the intestinal mucosa. Intestinal and gastric fistulas were made upon tweny-four young female dogs and records of the effects of intestinal stimulation upon stomach contractions were made. It was found that gastric juice, chyme, acids, alkalies, water, milk, oil, introduced in 10 c. c. amounts into the small intestine inhibited gastric hunger contractions and gastric tonus for varying periods. "The longest inhibition obtained in any one experiment was produced by 10 c. c. of milk in the gut. In this case the inhibition lasted thirty minutes." (4:198)

The writer of this paper has no objective experimental evidence that might help in the answering of the questions given above but believes that such evidence is necessary in order to answer them and makes the following suggestions for further investigations. (1) That by the devising of some apparatus—possibly an adaptation of the apparatus used in her treatment—the presence of and the interval of periodicity of duodenal contractions be obtained;[1] (2) that stomach contractions be recorded during a period of duodenal feedings; (3) if it proves that periodic duodenal contractions are existent that the effect upon these be determined (a) during stomach feedings, (b) during duodenal feedings, (c) during a period of starvation.

It may well be that the duodenal feedings given the writer were frequent enough to cause a continuous inhibition of the stomach contractions and that for this reason during the greater period of the treatment she did not feel hunger. If this does explain her lack of hunger it would be interesting to determine experimentally how long the interval between

[1] Carlson (4:82) mentions that in the duodenal fistula case of Busch contractions of the small intestines were noted in hunger.

duodenal feedings could be made and still have hunger absent. Whether or not the intestines play a rôle in the hunger sensation the writer cannot determine from any objective experimental evidence which she has, but that they do play such a rôle is suggested by certain introspections which she made during her period of treatment. As will be shown later in the paper, her introspective study of the sense of "fulness" convinced her that this was located in the small intestine and it was to this same location that she at times attributed "hunger." During the first week of treatment the duodenal feedings were begun at six o'clock in the morning. This generally necessitated waking her and as the feedings were begun immediately, time for introspection was lacking. On the last eight mornings of the treatment feedings were not begun until eight o'clock and on six, possibly seven,[2] of these mornings "hunger" was felt before the duodenal feeding was given.

Her introspections of this first morning, March 29, when she reported this early morning hunger contain the following statements: "Getting hungry: localized where the 'full' feeling is felt." On one other occasion, March 25, she wrote: "11:30. Feel a little 'hungry:' localized in the duodenum(?)." On March 28, 4 P. M. she wrote: "Before the feeding, felt fulness in the colon, also some sensation (pressure?, slight hunger?) localized in the lower stomach." On March 28, 4 P. M. she wrote: "Slight hunger: localization 'pit' of stomach." Later when she had more definitely localized the sensations in the intestine she felt that "lower stomach" and "pit" had really signified intestine. These introspections of the writer indicate that hunger may be felt at least partly in the small intestine. Perhaps it should be mentioned that at the time when the treatment was being given the previous experimental findings in regard to hunger, etc. were but vaguely known to the writer. The problem which she set herself at the time was to observe *when* she felt hunger, not *where* she felt it. For this reason she is inclined to regard her spontaneous though carefully made observations as of considerable value. During the period of the last three days hunger was reported as having been present at three times other than early in the morning but the exact time was not recorded. Her introspective notes show no localization of hunger except as quoted above. As stated before, localization was not her problem. Altogether then

[2] The writer did not positively identify the sensation of this morning as that of hunger.

during her two weeks of treatment hunger was felt but twelve times. It may well be that hunger was present at a few other times for strict attention to the problem was not always possible. Perhaps this is true of all hunger reports. At any rate the writer feels that her observations are on the whole truly representative.

Cannon, Washburn, Carlson, all make a good deal of the *time* relations between hunger and stomach contractions. They find that hunger is always reported *after* the beginning of stomach contractions. We have stated above that hunger was felt in the early morning before the duodenal feedings were begun and if it is true that duodenal feedings inhibit stomach contractions then this early morning hunger may have been due to the fact that the stomach contractions had not yet been inhibited because no feeding had been given during the night. But the fact that hunger was felt at other times during the day despite the fact that the time of duodenal feedings was kept constant is not so easily explained by this theory. To the writer's mind it raises the question whether or not after all the factor of "general weakness" is not a part of the hunger complex.

Hurst (7) quotes with approval Tiedemann's "admirable analysis of the sensation of hunger" in which hunger is said to be a sensation of emptiness of the stomach and the general sensation of malaise and weakness of the body as a whole. That hunger is more than local emptiness Hurst argues from the fact that in cases of prolonged starvation food relieves the emptiness but not the general feeling of malaise,

> "a much larger quantity of food being required to satisfy hunger of the starved tissues than that of the empty stomach. For the former digestible and nutritious food is required, for the latter bulk is of primary importance. This is well seen in patients with a fistula of the upper part of the small intestine . . . I have myself observed one. The patient was constantly hungry, although he ate enormous quantities of food. His stomach always felt full, but the general sensation of hunger remained, as most of the food escaped from the fistula with the result that the tissues continued to be starved." (7: 40-41.)

This general sensation of hunger Hurst thinks to be dependent upon the requirements of the tissues,

> "it is increased when these are excessive owing to abnormally active metabolism, as in diabetes and some cases of Graves' disease." (7: 40.)

The sensation of emptiness experienced during a period of starvation Hurst believes to be partly localized in the intestines. The cause of this sensation of emptiness is best explained by motor activity.

"The sensation of emptiness in the intestines, like the corresponding sensation in the stomach, can best be explained as a result of periodical motor activity in an organ which is abnormally excitable as a result of the absence of normal stimuli for an unusually long period." (7: 41.)

Carlson and Boring do not agree that weakness is a part of hunger. Both weakness and emptiness are accessories of hunger, according to Carlson. Emptiness he says is

"a peculiar feeling in the entire abdominal region. This feeling is continuous, not intermittent like the pangs of hunger. . . . It is probable that the increased tonus of the abdominal muscles in consequence of the empty state of the stomach and the intestines, contributes to the feeling in some way. . . . We question whether any part of the feeling of emptiness originates in the stomach itself. It is not so difficult to understand how a hypertonic and rhythmically contracting empty stomach may give rise to the sensations of tension, pressure, and gnawing pain. But how can it cause the sensation of emptiness, unless this feeling is merely negative of the sensation of fulness? On the other hand, if the tonus of the abdominal muscle does not suffice to maintain the normal intra-abdominal pressure when the stomach and the intestines are relatively empty and strongly contracted in hunger, the tension on all the visceral organs would not be diminished and this in turn would alter the pressure relative to the peritoneum and mesentery. If this is the factor in the origin of the feeling of abdominal 'emptiness' in hunger, the sensation should be diminished in man by lying down, in comparison with that felt when standing." (4: 93-94.)

The writer of this paper has certainly always considered the consciousness of emptiness as a part of her hunger complex. As to whether or not this "emptiness" decreases upon lying down she cannot say. But in her case at least it was experienced while lying down.

As to Carlson's positive analysis of hunger, he writes: "It is more or less an uncomfortable feeling of tension, or pressure and pain referred to the region of the stomach." (4:6) He quotes with approval the following analysis of hunger given by Boring.

"Upon a background of dull pressure, which is sometimes recognized definitely as kinaesthesis or the equivalent muscular pressure, there is set a dull ache or gnawing pain which characterizes the hunger. Both pain and pressure are referred to the region of the stomach. The pain is noted as fluctuating, as rhythmical, as unstable." (4:25-26.)

Kinaesthesis, pressure, pain, seem then to be the components of hunger for both Carlson and Boring. Perhaps what the writer of this paper called "hunger" in the cases noted was not what these two would call hunger. Certainly she included in it what she calls emptiness. Also at times there was in it or perhaps one should say *with* it a consciousness of weakness. In this connection the following note from her introspections

is interesting. "April, 1. Up a little while today. Find myself very weak. Weighed, and found had lost seven pounds up to date since beginning treatment. Felt some 'part' of what have called hunger in the past: but hunger of the kind when I have felt sick. Rather bad, weak feeling; while the hunger in the morning is more localized. Is a gnawing sensation. This is a good feeling: feel fine when have it." This introspection indicates to the writer that the consciousness of weakness can be separated in introspection from the other sensations. Perhaps "emptiness" too could be so separated. But that the sensations located in the stomach should be separated out from the complex and be called "hunger" while those in the intestines should be called "emptiness" seems hardly justifiable. Probably all form a part of hunger. To the writer's mind hunger is a perception. Moreover she finds that in her everyday life what functions as "hunger" contains the sense of "emptiness" more often than it does pain. May it not be that this is a question of individual differences? The writer is reminded of Boring's analysis of appetite in which he points out that the stomach mucosa sensations which Carlson gives as a necessary part of appetite seem to be an individual affair. He writes: "In interpreting this pattern as an essential component of appetite, Carlson and Braafladt presumably put upon it their own individual meanings, which are, apparently, not completely in accord with those of other observers." (3:453) May not the same thing be true of hunger? Boring would probably dissent to this, insisting that the difference in the two cases is that in hunger we are dealing with a fusion of sensations while in appetite we have an attitude or meaning. If this is true then in the former case all normal persons would have the same components fused, while in the latter the sensory processes correlated with the attitude might vary in different individuals. The writer is raising the question whether it may not be true that hunger too is an "attitude" rather than a fusion? She certainly believes that the meaning of hunger is a constant part of hunger and she raises the question whether or not the sensory components (if one can make this distinction between meaning and sensory components) may not vary in individuals? Had she a record of her stomach contractions during her treatment she might conclude that only during stomach contractions did she feel hunger. But may it not also be true that without this sense of emptiness she would not experience hunger? Certainly she always did sense emptiness when she was hungry. And it is true that

she experiences what she calls hunger when pain is absent. Carlson and Boring report hunger without emptiness but always have pain in hunger. May it not be that in all of these cases hunger is present but with different sensory components? Or perhaps certain sensory components (perhaps kinaesthetic) are always present in hunger while other components vary in different individuals?

As to the consciousness of weakness the writer is inclined to agree with Carlson that this is not necessary in hunger. In her own experience, as her introspections show, hunger, at times, seemed to be accompanied by a consciousness of buoyancy and strength while at other times by that of weakness. This is also true of the hunger felt in the writer's every day life. On the other hand her introspections during treatment show that hunger was felt after exertion more than at other times.

Before leaving the discussion of hunger it is interesting to add part of a conversation with Dr. Einhorn, who feels that the need of food plays a part in the hunger process and points out the fact that in over 500 cases in which he has given the duodenal feeding treatment in very few instances is hunger reported to him. This is not true of rectal feedings where assimilation of food is much less than in the case of duodenal feeding. It may be, of course, that duodenal but not rectal feedings inhibit stomach contractions and hence the lack of hunger in the first case and the presence of it in the second case is accounted for. This is one of the points which future investigation will probably answer.

Appetite.—As to appetite during the treatment never did this force itself upon consciousness but came only when sight, smell, or the thought of food provoked some desire for it. This never happened however after a duodenal feeding, such a feeding seeming to "satisfy" the appetite. When appetite *was* felt there was decided "mouth-consciousness," i.e. kinaesthetic images of tongue movements, pressure images of "pucker," what seemed to be sensation from increased salivation. At times when the food was seen there was a motor tendency toward it. There seemed to be no gastric component present. Sometimes immediately before a duodenal feeding was given the writer watched food served and "desire" for food was often felt. In no case, however, did this *arouse* hunger. Introspections for 7-7.30, March 29 read: "Getting hungry: watched trays served, great desire for food tastes. 'Coffee-ah!' 'Brown rolls!' (these in vocomotor imagery)." With these images went the accompany kinaesthetic and pres-

sure images and sensations in the mouth. From her experience the writer believes that hunger and appetite are separated conscious states or attitudes. There may be mutual influence in a number of ways.

Sensation of Fulness.—One of the most outstanding features of the treatment was what the writer called the sensation of fulness. When the feedings were first given a rather widespread reaction occurred. Warmth (a sort of flushing) was felt over the whole body, most marked in the face and limbs. A thrilly, tingling feeling in arms and legs was rather dominant. This went up and down the limbs much as a shiver runs up one's back, but in this case it was a warm running thrill not a cold sensation, as in the case of shiver. A feeling of weakness was present and toward the end of the feeding a sensation of fulness. It is hard to describe this sensation for although it has some of the sensory components of what we sometimes term "bloating" or consciousness of gas in the intestines it had more localized muscular sensation than this. It seemed to be localized in one place, high up in the abdomen. Fulness seems the only word to express the sensation. It was somewhat like the sensation occasioned when upon washing out the stomach one feels that as much water as one "can hold" has been poured in and that it must be taken out. In both cases, i.e. in both the stomach and the intestine, fulness may pass over into nausea. In the case of the duodenal feedings there was a consciousness of pushing against the stomach, at least it seemed to be against the stomach for it was against that part where nausea was being felt. Nausea has always seemed to the writer to be localized in the stomach. At least it seemed higher up than the sensation of fulness, when they were present at the same time. Toward the end of the period of treatment the sensations of warmth, weakness, thrilling were not present in any marked degree. The sensation of fulness was present in all feedings and never was the writer able to take the feedings while sitting up. This seemed to increase the sensation of "fulness" and gave an added dragging-down sensation. It also occasioned the nausea more easily.

From experiments Hurst concludes (7:35) that the "sensation of fulness" is due to the stretching of the muscular coat and is probably shared by all hollow viscera. Carlson (4:112) points out that there must be a certain amount of tonus reaction of the stomach before tension or pressure on the walls of the stomach will produce the sensation of

fulness. The fact that the writer of this paper did not feel this sensation of fulness until the end of each feeding and that the sensation was felt more easily and markedly when the food was forced in more rapidly lends support to Hurst's contention, although one wonders if the food stays in one place long enough to give rise to muscular distention. At any rate the sensation of fulness *was* present under the conditions mentioned and apparently the small intestine is sensitive to distention. It may be mentioned that although qualitatively the sensation of fulness in the intestine resembled the sensation of "fulness" felt in the stomach after a very large meal, it was not felt in the same place.

One factor that made at least relative localization of sensations fairly easy and certain, was that the writer was experiencing fairly constant pain in the pyloric region of her stomach—due, probably, as tests revealed, to inflammation in this region. Both the sensation of fulness and hunger (at times) were localized lower than this pain. It should be stated that the writer's stomach is considerably dilated and that for this reason the localization of her sensations may be wrong. Even so the relative positions would be correct.

Thermal Sensitivity.—A few rough observations were made upon thermal sensitivity. Of course the tube used in the treatment was very small and single-walled thus allowing heat or cold to be quickly conducted to the surface. But as localization of alimentary sensations has been found to be pretty accurate this fact need not invalidate her observations. The writer believes that during her two weeks of treatment she became pretty competent and accurate in her ability to localize a sensation as one coming from the different parts of the alimentary canal. The strict localization of her pain and of her sense of fulness and hunger gave her what might be termed "land-marks." And then again introspection is not a new business to her.

The problem of the thermal sensitivity of the stomach seems to stand somewhat as follows. Hurst found that water from 40-50 degrees C. and also ice-water introduced into the stomach by means of an india rubber tube placed inside an ordinary stomach tube gave no thermal sensations (7:5). Boring, also using a double-walled tube, found that water at from 50-80 degrees C. produced a sensation of warmth and water at from 0-30 degrees C. a sensation of cold, both being referred to the stomach. (1:40) Carlson too concludes from experiments that "The stomach mucosa is endowed with heat and cold nerve-endings." (4:111)

From her own experience the writer believes the oesophagus, the stomach and the duodenum to be sensitive to thermal stimulation, the latter two being sensitive only when the stimulus is rather extreme, and the duodenum possibly not sensitive to warmth. In most cases the sensation of warmth occasioned by her feedings was confined to the upper part of the oesophagus. On March 28 attention was turned for the first time to this problem and introspections of that day read: "During several of today's feedings gave strict attention to temperature sensations: could sense none although when I forced the food down more rapidly it felt a little different." On March 29 introspections read: "No temperature sensations on forcing it faster." At other times when the food was given hotter than usual a vague, undefined sensation was felt in the stomach and duodenum. This was not recognized as warmth.

On the day that the tube was to be withdrawn Dr. Einhorn kindly consented to allow the writer to perform a few experiments upon thermal sensitivity. These consisted in having an experimenter[3] very forcibly inject a syringe full of water at varying temperatures through the tube into the duodenum. The writer opening wide her throat, held the tube away from the mouth and throat surfaces, closed her eyes so as not to know what stimulus was being given, and observed and reported the sensations experienced. One syringe full of water at each of the following temperatures was used with the following results. At 40° and at 44° Fa. unmistakable cold was sensed. This was very widespread in the abdomen and according to the writer's best introspective ability was localized both in the stomach and in the duodenum. At 54° the cold did not seem so widespread and it was doubtful whether or not it was at all localized in the duodenum. At 104°, 106°, 108°, 112° Fa. warmth was felt in the stomach but it was not as widespread as the cold and the writer felt rather doubtful about its being in the duodenum. At 115° it felt considerably "hotter," more widespread, and was possibly sensed in the duodenum, although the writer was not sure of this last point.

The writer offers these few observations on thermal sensitivity not as conclusive evidence in any sense but merely as having suggestive value. The experiments, together with her observations during the whole treatment, do incline her to the view that the stomach certainly and the duodenum prob-

[3] The writer's brother, Dr. Malcolm S. Campbell, kindly performed these experiments.

ably have thermal sensitivity. Both seem more sensitive to cold: although higher degrees of warmth might have given different results. The whole problem should be put to further experimentation.

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PLEASANTNESS AND UNPLEASANTNESS IN RELATION TO ORGANIC RESPONSE

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In a previous study[1] of mixed feelings we came to the conclusion that pleasantness and unpleasantness are not felt simultaneously but only in alternation. This incompatibility indicates the existence of two opposed physiological mechanisms which are involved in affective response.

We have thought that a comparative study of the organic-kinaesthetic processes of pleasant and unpleasant feeling might throw light upon the nature of affective opposition. Accordingly we have taken for an experimental problem the following: is there any characteristic difference between the organic-kinaesthetic factors of P and U feeling which may throw light on the physiological mechanism of affection?

We have evoked feelings by simple, single stimuli: odors, tastes, tactual impressions, and a few chords. The feelings aroused vary intensively between the mild aesthetic feelings and strong emotion. Following is a complete list of the stimuli used:

Olfactory: wintergreen; caproic acid; creosote; castor oil; white rose perfume; asafœtida; cod liver oil; nitro-benzole; peppermint odor; camphor; anise; violet perfume; heliotrope perfume. *Gustatory:* vinegar; castor oil; chocolate peppermint candy; sarsaparilla; salted almond. *Tactual:* stroke with velvet; tickle ear; slap with lamella; sandpaper chin and nose; snap on cheek with rubber band; pain from sharp nail; extension of arm for 60 sec. *Auditory:* chords and discords.

The subject was seated in a Morris chair, eyes closed, in a room specially prepared for the experiment. Every S worked two hours a week, at approximately the same time of day; a single session took from ½ to ¾ of an hour. The work was done during the winter of 1919-20, and was broken by the Christmas holidays.

The following instruction was finally adopted after several slight modifications:

[1] Young, P. T., An Experimental Study of Mixed Feelings, *Am. Jour. of Psychol.*, 1918-19, 237-271.

"In this experiment be passive and receptive. Let the experimental situation have its full normal effect upon you.

"Report all muscular tendencies and organic sensations in any way related to the affective reaction.

"Report whether the experience was pleasant, unpleasant, or indifferent; and indicate the intensity of the feeling (using, for example, such terms as 'very weak,' 'weak,' 'moderate,' 'strong,' 'very strong')."

Our subjects were five men and two women, all connected with the psychology department at the University of Minnesota.[2] We shall designate these subjects by letter: A, B, C, D, E, F, G.

TABLE I

TOTAL NUMBER OF REPORTS

Subject	A	B	C	D	E	F	G	Total
Pleasantness....	25	17	12	6	27	26	9	122
Indifference*....	19	6	12	2	14	4	13	70
Unpleasantness..	34	29	8	8	41	17	11	148
Total.....	78	52	32	16	82	47	33	340

*"Indifference" includes all reports in which pleasantness and unpleasantness are not specifically mentioned, as well as those in which the experience is described as indifferent.

RESULTS

The total number of reports in the experiment is shown in Table I. It will be noticed that there is a good balance between P (122) and U (148).

Of the specific organic-kinaesthetic processes reported by our subjects the most frequent are:

Muscular strain, tension, shivers, shocks, jumps, moving waves of sensation; relaxation; incidental movements such as chewing, swallowing, tongue movements, jaw movements, eye movements, special associated movements, etc.; warmths, colds, pressures referred to the chest, heart and trunk; observed changes in respiration and circulation; perception of passive movement, of the flow of saliva, of tendency to vocalize; kinaesthesis of amusement, smiling, frowning; anger, expectation, surprise, nausea, sneezing, snarling, etc.

Correlations.—A preliminary survey of our data shows clearly that P and U are frequently reported without any mention whatsoever of organic and kinaesthetic accompani-

[2] The subjects were: Dr. R. M. Elliott; Dr. (Miss) M. Fernald; Dr. (Mrs.) J. C. Foster; Dr. W. S. Foster; Dr. J. J. B. Morgan; Mr. O. P. Pearson; Mr. C. P. Stone.

ments. Of course there may be subliminal physiological changes accompanying every P and U feeling which, conceivably, might be detected by an ultra-refined expressive method. However, peripheral changes were not observed by our subjects in a large number (38%) of reports. We conclude that there is no sensory *sine qua non* of P and U.

Consequently we must limit our investigation to reports containing specific mention of organic-kinaesthetic processes. Apparently there are a few specific correlations generally recognized in daily life. Smiling, for example, appears to be correlated with P; frowning and snarling with U; nausea (3 cases) with U, etc. There is also a suggestion of correlations between P and U and changes in respiration. However, no conclusions can be drawn safely from our data, and the correlations in question are best studied by the physiological methods.

If, however, we examine the reports more closely, we find a general correlation-tendency of considerable interest. Muscular strain (tension) is correlated with U, while its opposite, relaxation, is correlated with P. In 28 reports strain is associated with U feeling, and in 31 muscular relaxation is associated with P. The distribution of these reports is shown in Table II. This result confirms previous work.[3]

Following are sample reports in which muscular strain (tension) is associated with U:

TABLE II

MUSCULAR STRAIN AND RELAXATION IN RELATION TO PLEASANTNESS AND UNPLEASANTNESS

Subject	A	B	C	D	E	F	G	Totals
Strain with Unpleasantness	7	8	0	5	0	7	1	28
Strain with pleasantness	0	2	0	0	0	1	0	3
Relaxation with Pleasantness	6	0	7	3	3	12	0	31
Relaxation with Unpleasantness	0	0	0	0	0	0	0	0
Total Reports	78	52	32	16	82	47	33	340

[3] Hayes, S. P., A Study of the Affective Qualities, *Am. Jour. of Psychol.*, Vol. 17, 1906, 358-393. "For all observers alike, . . . judgments of strain were easy and, on the whole, direct. Strain was, however, described in 'muscular' terms throughout, and increasing strain meant, uniformly, increasing unpleasantness." Three of Hayes' subjects make relaxation the opposite of unpleasant strain and the curves are curves of pleasantness; one other subject considers relaxation a pleasurable muscular attitude or a pleasurable organic set.

"U. mildly so . . . I noticed that my hands were crossed quite tightly with a tension that increased slightly." A 29. "That was distinctly U. There was quite a foreperiod of apprehension—a straining." A 41. "It was U, meaning that there was some tension in the muscles around the nose, possibly tending to curl it up and withdraw it." A 65. "That is U but one's main interest is in balancing the strains all over the body." A 67. "That was U, rather unexpectedly so . . . Quite a degree of tension as compared with the muscle position assumed for P and relaxing stimuli." A 71. "There was the usual degree of tension that characterizes the foreperiod of expecting U as I did then. The tension there seemed to be lateral where the tension for the U odor seemed to be vertical." A 72. "That was U. I didn't notice any particular kinaesthesis except a slight tightening of the muscles of the lower part of the nose and the upper part of the lip." B 13. "Decidedly U . . . Tightening up of the eyes—a tense closing of them." B 23. "It was U. Quite a noticeable tightening of the muscles in the lower part of the face. It seemed to be the reverse of sniffing—the attempt to prevent air from coming in." B 25. "U . . . Only a very slight tendency to tighten the muscles about the nostrils." B 27. "I should say U, but very weak . . . Tightening of the muscles about the trunk." B 40. "U, strong. Tendency to shut off the breathing. Tendency to draw head away which was inhibited by the experimental situation. Tightening of muscles about the nose. Drawing together of muscles between the brows—a slight scowl." B 42. "Very faintly U. I didn't notice anything more than a slight tensing of the muscles concerned with smelling." B 46. "I should say very weakly U. I think there was some tenseness of the muscles about the nose and thorax." B 47. "That was U, rather moderately . . . First a little excitement, a little tension of the muscles." F 2. "A sudden tensing of the muscles as soon as you struck my cheek . . . It was U, though not so very U either, mostly surprise and tensing of the muscles in the right arm and also jerking away from where you struck." F 4. "Muscles had a tendency to contract. Face frowned . . . Very U." F 24. "A tendency to make muscles more tense. It was indifferent, or if anything weakly U." F 32. "Definite tensing of the muscles, pulling away to the side, turning of the head . . . Very U" F 44. "Quite a definite tensing of the muscles especially in the upper part of the body in the arms. Tendency to lift right arm and brush it away. Feeling was definitely U. Also during rubbing there was a tensing of the stomach muscles." F 49. "The feeling was U, very intense . . . A tendency to stiffen the muscles of the arm. That was a very slight feeling of stiffening of the arm—more like just tensing the arm." G 10. "At first there was tension and trifling surprise. During that time the feeling tone would be impossible to name; neither P nor U; exciting if you want to call it so; tensing if that is a feeling tone. Then the U which increased rather up to a maximum and then decreased a little. The U itself I can't say much about . . . A tension through my face." D 2. "That was U and exciting and perhaps somewhat tensing. The tension and excitement began before the first 'now' . . . The tension and excitement so far as I could tell were simply muscular feels in the cheek. The excitement was merely little contractions and quivers and that sort of thing. The U was many strains in a tendency to shake your head and get away from it—a frowning and possible tension through the body in the legs and arms as if to help you bear

it." D 5. "U, moderately strong . . . Something of the same kind of a shiver you get with the first reaction to cold. At the same time there was a general increase in the kinaesthetic tension, particularly noticeable in my chest, in my face and in my arms. In my chest there was kinaesthetic holding of my breath for a bit after a rather sharp inspiration. In my face there was kinaesthesis frowning and tensing all my face muscles. In my arm simply a special tension . . ." D 10. "U. The reaction was a kinaesthetic jump of my whole body. A sudden tension and then it was all over. I should say there was tension in my legs and tension in my chest and face strongest. There was frowning. Perhaps I should also add that there is a pretty strong tension in my neck is if to draw my head away." D 12. "Mildly U. General tension through chest and in face at first. The tension kept up in my face although I kept up breathing naturally . . . I think the general tension and the U both were even greater towards the end than towards the beginning . . . An increase of tension—general tension—after that." D 14.

Below are sample reports in which relaxation is correlated with P:

"P. I should say quite a bit more relaxation than in any other of the stimulus periods. I should call the pleasure the absence of kinaesthesis, the relaxation, the lack of opposing tension in the muscles." A 40. "Moderately P. A singular absence of kinaesthesis . . . I was thoroughly relaxed." A 55. "That had a forperiod of U. I was apprehensive. I was alarmed. I could feel the tension relax, particularly in the upper part of the head. My consciousness was next P by way of anticipation . . . The P I could find little basis for except absence of disturbing kinaesthesis." A 63. "Tension followed by relaxation and deeper breathing. All initiated before I had anything P except by ideational anticipation . . . Attention that accompanies your approach was rapidly followed by relaxation of the muscles and deeper breathing—P." A 66. "I don't know whether the P caused the relaxation." A 69. "That was P . . . The result was ease and relaxation which spread back and surrounded the violet (odor) without diminishing the degree of P which I had from the start felt from the violet." A 70. "It was moderately P. A feeling of relaxation. It tended to increase my relaxation." F 1. "That was a P odor. It tended to make me more relaxed—to stretch." F 17. "It had a calming effect; tendency to relax. Very P." F 23. "At first a litle tension but the effect of the taste was calming, relaxing, soothing . . . It was moderately P." F 33. "It had a calming, soothing effect. A tendency to relax—was quite P." F 34. "Soothing, calming effect seemed to be localized in the front of the nose. A relaxing effect on the body. A tendency simply to let go. Very P." F 36. "A definite tendency to relax . . . It was very P." F 40. "Definite sensations from the central part of the chest. Produced a sort of diffused feeling. A slight tendency to relax. Moderately P." F 42. "Odor had a very soothing, calming effect. A tendency to relax—very P." F 45. "I believe a slight tendency to relax although it was approximately indifferent. A weak P feeling produced." F 47. "A slight tendency to relax. Weakly P." F 48. "Mildly P. Slight relaxation." C 8. "That is mildly P. It is relaxing, reminiscent." C 11. "P. Mildly P. A rather clean and clear and relaxing kind of a thing." C 15. "The feeling tone changed.

At first it was P and then tiresome . . . At first a relaxation and various fleeting images but that all went before the end." C 16. "There was conscious relaxation, a breathing slower and deeper in an effort to give myself up to the smell. A fleeting wonder if I would have time for a second intake of breath. My judgment now is that it was mildly P, that I would have had the same P if I had relaxed and breathed more slowly and deeply without any smell." C 21. "When I realized that it was a smell there was the usual relaxation—deep, slow breathing . . . I think the smells give me a kind of day-dream relaxation that is mildly P. I mean it is a P way to occupy your time till something more interesting comes up. You are simply passive." C 24. "That was P. There was a general relaxation, deeper breathing." C 30. "The P was a relaxing P rather than an exciting P." D 3. "I think of the experience in parts, and tend to report that the straining parts were U and the relaxing parts or moments were P." D 6. "Slightly P. I should say that the chief thing was a bit of relaxation very mildly felt through the chest and general muscular system, considerably more through my face." D 13. "P. Sort of a soothing effect. A tendency to relax." E 11. "That was P. I think there was a feeling of relaxation when I found it was the candy and not the vinegar." E 18. "That was P, fairly intense. I didn't observe any kinaesthesis. The soothing effect is a tendency to relax more." E 43.

The tendency for strain to occur with U and for relaxation to occur with P is by no means necessary and invariable. In the first place, we have several reports of strain and relaxation in which no mention is made of either P or U. In the second place, while the straining attitudes of anticipation, sensory preparation, attention, etc. are generally U in our data, there is no *a priori* reason why such strain should not occur simultaneously with P. The three reports (Table II) in which strain is associated with P are of this sort. In every case, however, the P is very weak, and there is no guarantee of strict simultaneity of strain and P.

"I should say it was very weakly P . . . Tendency to tenseness of some of the facial muscles (related to the questioning attitude)." B 43. "I should say it was very faintly P. I didn't notice anything in the way of response other than a slight tensing of the muscles about the nose (related to olfactory attention)." B 45. "A very little tension in the muscles. It was P, I think, though not very much—a low degree." F 3.

In the third place, we have six reports in which the subject was asked to hold out the arm for 60 sec. In three cases the strain produced was U. In the other three, however, it was indifferent or "interesting." A laboratory attitude may make

a strain mildly agreeable! Hence the U is not intrinsic to the strain,[4] for strain is not necessarily U.

From the above considerations we conclude that the association between strain and U, and between relaxation and P, is not necessary and invariable. In this it resembles the correlation-tendencies found by the expressive methods.[5]

Intensity of response in relation to P and U. Our data make it possible to investigate the relationship between intensity (or extensity) of bodily response and P-U. The reports contain (1) organic-kinaesthetic processes related to the affective reaction, (2) the corresponding feeling with frequent mention of its intensity. What is the relationship between P and U, of different intensities, and the number or amount of organic-kinaesthetic processes reported?

To answer this question we have given every report an 'organic score' which shows the number of separate organic-kinaesthetic processes reported. As this rating was in no case greater than four we adopted a five-point scale: 0 1 2 3 4. A few reports contain processes which apparently have no relation to the affective response, such as the incidental and accessory movements of chewing and swallowing, and random eye-movements. These movements, when reported, have *not* been included in the count and are *not* shown in the organic scores. Whenever there was any doubt as to the significance of the association between organic-kinaesthetic process and affective reaction, as in the case of heart-sensa-

[4] We have a large number of reports showing the dependence of P-U upon mental attitude or "brain set." "If I take the laboratory attitude, it is P no matter how U it may be. It is either P or U according to my point of view." C 9. "One difficulty is from the attitude of being in a laboratory experiment. There is a mild P all the time. Most of the experience is P from that point of view." C 19. "Neither I guess but I haven't the slightest objection to your calling it mildly either . . . I can't tell you anything about the two judgments except that evidently I have different points of view." C 21. "Potentially U but again rather interesting and interesting things are intrinsically P." C 22. "I imagine that if I didn't like doing laboratory experiments, I'd spit out the vinegar and the fact that I do swallow it means that I like it from one point of view." C 27. "That was U, of course, but it was so mixed with interest that I hate to call it U. I don't want to call it U because I was distinctly interested." 32. "I imagine you could give me pretty disgusting odors and I'd find them P. They are interesting. It is interesting to get down into an an odor." A 34. "In so far as it became interesting it wasn't U." A 49.

[5] Leschke, Erich (Die Ergebnisse und die Fehlerquellen der bisherigen Untersuchungen über die körperlichen Begleiterscheinungen seelischer Vorgänge, *Archiv. f. d. ges Psychol.*, 1914, 31, 30), finds an agreement of about 90% among previous investigators.

tions, chest-pressures, and the like, these processes *have been* included in the count. The organic score of a report, therefore, represents the number of probably significant organic-kinaesthetic processes reported. We have taken it as an index of the intensity or extensity of bodily response.

That there may be no misunderstanding as to the meaning of the organic score we give below a few examples of reports of every grade on our scale.

Reports with organic score of 0:

"Rather P. I couldn't detect any kinaesthesis there at all." E 20.

"Quite surprisingly U . . . I had expected something P because the same stimulus was P. I was surprised." A 20.

"That was P, quite P . . . The only kinaesthesis was that of the actual movements of chewing and swallowing." B 32.

Reports with organic score of 1:

"Very P and intense. A tendency to breathe deeply . . ." G 25.

"Rather U. A kinaesthetic tendency to pucker up my nose." E 22.

"U. . . . a slight tendency to scowl— a tightening of the muscles about the eyes." B 12.

Reports with organic score of 2:

"Quite P. A calming, soothing effect, a tendency to relax. I wanted to inhale as much as I could. Organic sensations from the heart and chest, moderately diffuse . . ." F 34.

"Not so very U . . . I was aware of the usual pinching, withdrawing response. The whole situation was sufficiently marked to produce reverberations that accompany most of the U stimuli . . ." A 45.

"That was very U. A tension of the muscles, especially those of the face and mouth. The muscles in the rest of the body were also made more tense and I seemed to get that feeling of tension toward the stomach." E 8.

Reports with organic score of 3:

"Decidedly U. A definite jerking back of the head. Tightening up of the eye muscles—a closing of them. I was aware of circulatory changes localized in the spot struck and I should guess that there was a rush of blood to the face for that particular spot felt hot." B 23.

"Moderately U. The first tendency was to refrain from breathing. The second was to move my head away. There was also a tendency to contract the muscles about the nose and upper lip." B 49.

"It was rather relaxing at the most P part. At other times I think it was mainly exciting but not relaxing . . . It is true that there were curious little quivers and trembles and reverberations through my fist and it is true that there was a tendency to smile but it does not seem correct to say that they *were* the P but rather that they were the expression of the P as well as of the relaxation and the excitement." D 8.

Reports with organic score of 4:

"That was distinctly U. There was a foreperiod of straining apprehension and a kinaesthetic tendency to look up . . . The rap was very sharp and I felt a twitch throughout the length of my body . . . The reflex was followed by one of those warm waves that goes over you—an unpleasant keying up of the body . . . There was distinctly a vasomotor change . . ." A 41.

"That was very U. A tension of the muscles especially those of the face and mouth. The muscles in the rest of the body were also made more tense. I also seemed to get that feeling of tension down towards the stomach. I seemed to get a taste of the liquid in the œsophagus. It seemed to be something going down—U." F 8.

TABLE III

AVERAGE ORGANIC SCORES

	Pleasantness			
	Weak	Average	Strong	No Report Intensity
Number of Reports	34	29	31	28
Their Total Organic Score	25	23	23	16
Average Organic Score	0.7	0.8	0.7	0.6

	Unpleasantness			
	Weak	Average	Strong	No Report Intensity
Number of Reports	47	29	27	45
Their Total Organic Score	45	45	61	43
Average Organic Score	1.0	1.5	2.2	0.9

	Indifference
Number of Reports	70
Their Total Organic Score	37
Average Organic Score	0.5

Table III shows the average distribution of the organic scores. From it several conclusions may be drawn.

First, the average organic scores for U are in every case greater than those for P. If we take the total P reports as a class, we find an average organic score of 0.7 ± 0.6; the same for U gives 1.3 ± 0.7; and for I, 0.5 ± 0.7. Although the

M.V.s are relatively large, indicating that the organic response has a considerable range of intensive variation, they are practically constant for all classes of report. The total number of reports upon which these averages are based is: P, 122; U, 148; I, 70 (Table I).

Secondly, the organic scores for U increase with the intensity of feeling. The more intense the feeling, the more widespread is the bodily reaction. For P, on the other hand, no such relationship appears. The average organic scores for P are practically constant for all intensities and classes of P. The 31 reports of intense P have exactly the same average score as the 34 reports of weak P.

Thirdly, the average organic score for the reports of indifference is less than any score for P or U.

When no intensity is reported the organic scores lie midway between weak feeling and indifference, and we hazard the guess that the feeling-intensity of this class of reports is, on the average, very weak. As the intensity of P and U decreases, the organic scores approach that of I.

We should note that relaxation is included in the organic scores of P as a significant process. Some of our subjects describe relaxation as the "letting up of strain," "the absence of kinaesthesis," *i.e.*, they tend to regard relaxation negatively as the release of strain.[6] Suppose that we assume that relaxation is negative, merely the release of strain, and on the basis of this assumption eliminate relaxation from the organic scores. If we do this, the organic scores for P become equal to that of indifference. Hence, with our data, P is differentiated from indifference primarily by relaxation, which itself is negative and represents a return to indifference (from one point of view) rather than a departure from it.

If, for the sake of comparison, we eliminate strain from the U reports, the average organic score is reduced from 1.3 to 1.1; and the latter is well above indifference (0.5).

---

[6] Shepard, John F., Organic Changes and Feeling, *Am. Jour. of Psychol.*, 1906, 17, 522 ff. "Strain is described as composed of sensations from the muscles, the backflow from the acting muscles, particularly those of accommodation of a sense organ. . . . Relaxation seems to be a release from either strain or excitement." Cf. Titchener, E. B., Zur Kritik der Wundt'schen Gefühlslehre, *Zeits. f. Psychol.*, XIX, 1899, 321 f. Our result confirms the later polemical work against the Wundtian theory as regards the nature of strain and relaxation.

TABLE IV

AVERAGE ORGANIC SCORES WITH CUTANEOUS STIMULI ELIMINATED

	Pleasantness			
	Weak	Average	Strong	No Report Intensity
Number of Reports.....	34	27	29	28
Their Total Organic Score..	25	20	23	16
Average Organic Score.....	0.7	0.7	0.8	0.6

	Unpleasantness			
	Weak	Average	Strong	No Report Intensity
Number of Reports.....	38	13	11	23
Their Total Organic Score..	35	17	27	15
Average Organic Score.....	0.9	1.3	2.4	0.65

	Indifference
Number of Reports.....	55
Their Total Organic Score.....	27
Average Organic Score.....	0.5

It may be objected that the foregoing result is due to the selection and balance of stimuli. The cutaneous stimuli (slaps, pinches, etc.) were for the most part U while we had no stimuli capable of evoking correspondingly intense P. Had we used other stimuli and more intense P situations the differences of the curves might disappear.

To test this criticism we have eliminated all cutaneous reports and worked out average organic scores for the remaining odors, tastes, and chords (Table IV). We believe that simple odors, tastes, and chords are comparable from the affective standpoint. The elimination of cutaneous stimuli reverses the P-U balance (P 118; U 85. See Table I). However, the conclusions still stand; the differences are even

clearer than before. The U curve is steeper. Consequently the presence of a relatively large number of U cutaneous stimuli does not account for the differences in the organic scores.

As regards intensity, we have no means of comparing P with U. We do not know whether the "intense P" of a perfume is equal to the "intense U" of caproic acid, and whether the "moderate P" of peppermint-candy is comparable with the "moderate U" of vinegar. It would be worth while to study these organic curves at higher levels of feeling-intensity. We may conjecture that the P curve would rise slightly and gradually, and that the U curve would rise suddenly and abruptly to a point much higher than the most intense P would reach.

We should note, however, that the relative numbers of "weak" "average" and "strong" Ps and Us are about the same (Table III). The intensive balance of our reports is very good.

Fundamental characteristics of the unpleasant response. An analysis of our data brings out several fundamental characteristics of the U response.

First, there is the well-known tendency to withdraw oneself from the stimulus-object, either reflexly or deliberately.

"Much the strongest avoidance impulse so far . . . It was all I could do to keep from brushing it away." A 38. "U. Quite a definite desire to withdraw and prevent one's face from being damaged." A 64. "A decided tendency to draw my head back which was not inhibited in this case." B 15. "I got away from it. The kinaesthesis was a definitely overt action." B 28. "Slightly U. I reduced the intensity of the sensation by drawing my head away." B 37. "U, strong. A tendency to shut off the breathing—to reduce it. Tendency to draw head away . . ." B 42. "Moderately U. The first tendency was to refrain from breathing; the second was to move my head away." B 49. "The head was jerked aside with the blow. It was moved to the left." G 32. "A very strong tendency to turn the head away from the odor." F 14. "First just a little start or shock. A tendency to draw the head up and back away from the spot rubbed." F 30. "Immediately there was a tendency to jerk my head away and to push away with my right hand." F 35. "A great deal of kinaesthesis particularly in my eye-lids as if protecting my eyes from a blow and a general tendency to shrink away." C 2. "A tendency to stop up my ears and to draw away from the stimulus." C 9. "The U was many strains in a tendency to shake your head and get away from it—and frowning and possibly a tension through the body in legs and arms as if to help you bear it." D 5.

Secondly, closely related to the above is the tendency to put the object away from oneself or to prevent its action. Bio-

logically this type of response has the same purpose as the above.

"Provoked kinaesthesis of pushing the stimulus away—in the left arm in particular." A 19. "It was all I could do to keep from brushing it away." A 38. "The organics of an odor like that lead one to reflexes of repulsion." A 42. "U. Quite a noticeable tightening of the muscles in the lower part of the face. It seemed to be the reverse of sniffing—an attempt to prevent air from coming in. If I'd been wholly natural, I'd have closed the nostrils with my hand." B 25. "U, rather strong intensity. I got a movement of my intestines, a sort of nausea. It was an expulsive movement preliminary to vomiting." E 51. "I had a tendency to move my mouth to blow it away. It was disgusting. I thought I got a little nausea." E 56. "A tendency to lift up the right arm and brush it away. Tensing of neck and jaw muscles." F 49. "A tendency to stop up my ears and a tendency to draw away from the stimulus." C 9. "I tended to spit it out. Then the laboratory attitude came back . . . If you get too naïve and too relaxed you have a physical reaction and nothing else. I think that time I would simply spit it out." C 14. "I am perfectly sure that under other circumstances I should have actually reached up and knocked away the stimulus from my chin." D 10.

Thirdly, there is a tendency to inhibit or resist (frequently due to the experimental situation) some normal response to the stimulation.

"A tendency to keep it in my mouth rather than to swallow it." B 18. "U. There was a much weaker tendency to resist smelling than in the other case. Only a slight tendency to tighten the muscles about the nostrils to the extent that it interfered with breathing." B 27. "I tended to inhibit the movement of swallowing. I think there was some tenseness about the nose and throat which may have been connected with my inhibiting of the swallowing." B 47. "The first tendency was to refrain from breathing. The second was to move my head muscles and to hold the head in position against any increase in pressure." B 15. "There was some resistance to swallowing although it was swallowed." G 20. "A tendency to resist the stimulus." E 27. "Slight stiffening of the neck to hold the head rigid as the friction was increased." G 18. "A slight tendency to shut out the noise . . . to put my fingers in my ears." G 30. "There was a movement in my cheek muscles and my facial muscles producing a frown and a reaction against the stimulus in the opposite direction." E 48. "There was a rivalry between the tendency to move the head away and to hold it there." E 61. "Kinaesthesis was localized in my chin—a resistance to the rubbing. A tendency to pull away from the placed rubbed." F 6. "I had to force myself to hold the chin still. A tendency to withdraw my chin from the rubbing." F 9.

Muscular strain or tension is frequently present in the form of anticipation of a U stimulus. From one point of view such strains may be regarded as the resistance to an expected undesirable situation.

Fourthly, the unpleasant response is accompanied by reflex twitchings, convulsive contractions, and bodily reverberations of various sorts, especially when the stimulus-object is presented suddenly and there is an element of surprise.

"At first a bit of suspense; then I jumped (marked reaction). Consciousness was empty there and the first thing I remember was the sensation from the jump . . ." C 10. "No feeling tone at first during the violent reaction, the jump. Then it began to tingle . . . There was a desire to slap back." C 25. "A little shiver of what one might call revulsion went through me. The shiver itself seemed to start in my chest and go even down into my legs. It was something the same kind of a shiver you get with the first reaction to cold." D 10. "The reaction was a kinaesthetic jump of the whole body. A sudden tension and then it was all over (S's face seen to twitch)." D 12. "At first a little shock. I didn't expect the sounds. It seemed to be spread down toward the fingers, the arms." F 3. "A slight jar or shock at the beginning of the playing. The shock was felt in the heart and chest." F 16. "A sudden start. A sudden tension of the muscles as soon as you struck me." F 4. "Quite a definite tensing of the diaphragm and a jump in the hand which tapered off rapidly." A 7. "Distinctly U. It starts reflex twitchings in every part of the body, particularly in your hands but also in your head and around your ear. Quite a mass of tendencies to react." A 22. "At first a start that is so reflex that it is done for you. Then after a slight pause the wave of sensation. It is a wave coming from my feet and rises higher and higher and then recedes." A 26. "Quite decidedly U. I very distinctly felt my heart give a thump. There was a wave-like twinge that goes up your back. This time I was conscious of it going down my right leg." A 36. "I felt a twitch throughout the length of my body. The reflex followed by one of those warm waves that goes over you—a keying up of the body." A 41. "The whole situation was sufficiently marked to produce reverberative reflexes that accompany most of your U stimuli." A 45. "I felt movement down my neck and chest as well as on my cheek (marked reaction)." E 33. "I had a movement in the pit of my stomach right beneath the floating ribs." E 39. "U, very intense. I got movement in my neck and facial muscles, twitchings (seen)." E 52. "There was a feeling as if perspiration came out. A muscular reaction—movement of the head." E 79.

Summing up the characteristics of the unpleasant response we may say that, first, there is a tendency to react away from the stimulus-object; secondly, a tendency to put the stimulus-object away from oneself or to prevent its action; thirdly, a tendency to inhibit or resist the normal repsonse (tension); fourthly, bodily twitches, shocks, waves of sensation, and other reverberative reflexes.

Analysis of the P response.—While U is associated with a large variety of reflex movements, P is passive and negative. Our data do not contain a single case of active reflex response to a P stimulus. With U there are withdrawing

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movements, frowning, straining, reflexes of expulsion, etc. while P is characterized by mere acceptance of the situation and the passive yielding to it.[7] Also the bodily reverberations which are associated with U (twitches, shocks, waves of sensation, etc.) are entirely absent from the P reports. U is organically positive and active while P is negative and passive. This general finding brings into relief the significance of relaxation. Muscular relaxation is the typical process associated with P and, so far as our data go, both qualitatively and quantitatively, differentiates P from indifference. Relaxation itself is negative and passive, a letting-up of strain.

The traditional relation between P and seeking movements finds little support in our reports, while that between U and withdrawal is abundantly confirmed. The entire evidence for seeking movements, as 'expressions' of P, is found in 11 reports, in which the subject "sniffed," "took a deeper breath in order to get more," "held the breath," etc. In every case these seeking movements are deliberate and never reflex like most of the withdrawing movements of U. It is a question to what extent and in what sense voluntary, deliberate behavior based upon the knowledge that P may be produced or prolonged, or U avoided, can be considered an 'expression' of feeling.[8]

Conclusions

Let us now ask the orginal question: is there any characteristic difference between the organic factors of P and U feeling which may throw a light on the physiological mechanism of affection?

I. A study of the processes reported by the subjects shows that there is no organic-kinaesthetic *sine qua non* of affection. P and U are reported in more than a third of the cases without any mention of organic-kinaesthetic processes; and when

[7] "I was willing to have the thing continued." A 4. "A relaxing effect on the whole body. A tendency simply to let go." F 36. "It is the kind of a thing you want continued." C 16.

[8] If we look at the question theoretically, it is clear that in many cases seeking movements are expressions of U: strong hunger, for example. The situation is complicated by the fact that the total seeking activity may become P, as when prey is sighted or food smelled. With the seeking movements of sex there is room for argument. Unsatisfied and unrestrained desire is probably U when associated with seeking. However, there may be vaso-dilatation, general relaxation, anticipatory imagery, etc., so that the total activity of seeking is P. Since positive seeking movements may be associated with either P or U, the traditional coupling of P with seeking is unsatisfactory.

such processes are reported, they bear no fixed and invariable relationship to the affections. However, a number of tendencies toward correlation can be made out, and of these the most probable is that between muscular strain and U and muscular relaxation and P.

II. A statistical study of the organic-kinaesthetic processes in relation to affection and an analysis of the reports themselves bring out the fact that: U is associated with a positive bodily response which becomes more intense and widespread as the feeling becomes stronger, while with P the bodily response is relatively slight. When one reacts away from the stimulus-object, or puts it away from oneself, or resists it (strain), or when bodily 'reverberations' are present, U is apt to be felt. P, on the other hand, so far as our data go, is organically-kinaesthetically negative. P is felt when one relaxes, or simply 'does nothing;' there are no reflex responses to the stimulus-object and no bodily 'reverberations.'

It should be remembered that any result is a function of conditions. Our subjects were seated quietly in a Morris chair, instructed to be "passive and receptive" and "to let the experimental situation have its full normal effect." In one of the earlier instructions they were asked to "make no resistance to the stimuli; to let them have their full effect." The *Aufgabe,* therefore, was to accept the stimuli calmly and quietly, or else as one does in ordinary life. With this set simple odors, tastes, tactual impressions, and a few chords and discords were presented. Those responses which are described as U involve a positive reaction which is absent with P.

AN EXPERIMENTAL STUDY OF KINAESTHETIC IMAGERY[1]

By Alice Helen Sullivan

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Introduction

In the first part of this paper we seek to determine the differences between sensory and imaginal kinaesthesis. It is often said that the kinaesthetic sensation and the kinaesthetic image are difficult or impossible to distinguish. We have attacked the problem by way of simple kinaesthetic complexes, experienced in their sensory reality and reproduced in imaginal terms. The results of this comparative study, attributive (sensational) and perceptive, are set forth on p. 67.

[1] From the Psychological Laboratory of Cornell University.

In the second part of the paper we have compared resident kinaesthesis with the projected kinaesthesis of the empathic experience. The results appear on page 78.

I. Kinaesthetic Sensation and Kinaesthetic Image Compared

We wished to obtain, for the purpose of comparison, a psychological picture of sensory and imaginal kinaesthesis, first in attributive and then in perceptive terms. We made out 50 short commands to be read to the *O*'s. We paired these commands for sensation and image thus: (1) "Think of: nodding your head once." (2) "Nod your head once." (3) "Raise your index finger once." (4) "Think of: raising your index finger once." In order that the *O* should not know when to expect a sensory or an imaginal stimulus, we arranged the experiments by this schema: IS IS IS SI SI II SS IS IS IS.[2]

O sat in a dark room, facing a black wall. *E* sat at a table a few feet behind *O*, and near a window through which a streak of light, just sufficient for his needs, was allowed to shine.[3] After *O* had read the instructions, *E* asked him to close his eyes. After a few minutes of rest, to free the eyes of *O* from possible images, *E* said "Ready," waited an instant, and read the stimulus-sentence. As he spoke the last word of the sentence, which was always "once," *E* started a stopwatch. When *O* said "Yes," indicating that the command had been obeyed, the watch was stopped.[4] Then the complete report of *O* was taken down. An interval of 15 sec. then elapsed before the giving of the next stimulus-sentence.

We began the experiments in May, 1919, and carried them on during the following months of June (with the exception of a two weeks' vacation), July, August, and October. There were seven *O*'s: Dr. L. B. Hoisington, instructor in psychology; Drs. H. G. Bishop and M. J. Zigler, assistants in psychology; Mr. P. J. Cavanaugh, Misses C. Comstock, R. Stutsman, and A. H. Sullivan, all graduate students in psychology.[5]

Experiment I.

We performed preliminary experiments, in order to try out our 50 paired commands, and to give our *O*'s practice in describing their processes. We noticed very soon that, in the

[2] I = Image; S = Sensation.

[3] A small shaded light was used for evening experimentation.

[4] We have not included the times in the following results, because we found no typical times for sensation and image, the time for the carrying out of the sensory and imaginal commands being approximately the same.

[5] St observed only during the summer term and did not complete the perceptive experiments. When the writer (Su) acted as observer, the experimenter (Ca, and later Miss M. F. Martin) made out new sets of stimulus-sentences.

pairs designated in the schema as SI, all *O*'s showed a tendency to be influenced in the imaginal part of the experiment by the report made upon the preceding sensory complex. The finding of attributive characters in the sensory complex suggested that the same attributes would appear in the image. An effort on *O*'s part not to be thus biassed resulted often in a complete inhibition of imagery.

Experiment II

In the light of these preliminary experiments, we settled upon the 15 paired commands which seemed simplest and yet were adequate for our needs. We also separated and distributed the sensory and imaginal members of the pairs, so that the schema SI SI SI etc. still held good, except that the imaginal member of a given pair preceded the sensory by a number of sentences.

The instructions read: "You are to follow the instructions which I shall give you and to report the experiences thus set up with especial reference to kinaesthesis.

"Every kinaesthetic experience may show perceptive characters (locality, pattern, etc.) and attributive characters (quality, intensity, etc.). In the present series I wish you to report the experienoe in terms of quality, intensity, and extent.

"You may neglect every other character of the kinaesthetic experience, and you may neglect all non-kinaesthetic experiences aroused by the presented stimuli.

"If, however, you find yourself noting any further feature of the experimental consciousness, I shall be glad if you will report it."

It was necessary to fractionate the experiences for report. In Group I we asked for quality, intensity, and extent; in Group II, for intensity, extent and duration; in Group III, for extent, duration, and vividness; in Group IV, for duration, vividness, and locality; in Group V, for vividness, locality, and temporal course; in Group VI, for locality, pattern, and course; in Group VII, for quality, pattern, and course. In this way we covered the attributive and perceptive characters a number of times, using always the same 30 stimulus-sentences. We took one practice-series with every new group, in order that our *O*'s might attain a fair degree of stability of attitude.

Stability of attitude was not attained at once. All *O*'s with the exception of Su were more familiar with visual imagery than with kinaesthetic. Visual images came constantly at first, and acted as a distraction. After training in the observation of kinaesthetic processes, much of the visual imagery dropped into the background, and the kinaesthetic processes were sufficient to carry the whole meaning of an imagined movement. Then the *O*'s showed more certainty about their kinaesthetic imagery. After training, the *O*'s were able also to describe more accurately the kinaesthetic sensory processes.

Sources of error due to wrong attitudes had also to be discovered and eliminated. Some *O*'s fell into the habit of holding or building

up the image, instead of letting it run its course naturally, as they did in the case of sensations. We had to make it clear to them that such "holding" was possible only by a shift of attitude.

Another source of error was that of using a different scale for sensation and image in reports upon the intensive attributes. We explained that the intensive characters mean distances from zero, and that the same scale could therefore be used in both cases.

Results

We found that, whereas the actual perception of movement aroused by our stimuli was very complex, having a number of different sensations whose attributes had to be reported upon separately, the image of the movement was in some cases for all *O*'s, and in most cases for a few *O*'s, actually a single image-process of one quality, intensity, etc., which carried the whole meaning of movement. An actual nod, *e.g.*, aroused several sensations; the thought of nodding aroused, in many instances, one simple image. In other cases, the attributive reports seemed to indicate a single image-process, but the perceptive reports which came later showed that the apparently simple process was in reality an imaginal complex, with a pattern and temporal course, which the attributive *Aufgabe* did not always bring to light.

We have tabulated our results in parallel columns for sensation and image.[6] There was no mention of the terms image and sensation in the instructions; and yet our stimuli were cut closely enough so that all *O*'s reported, with as much assurance as they would show in reporting upon visual sensations and images, "I observed a kinaesthetic image," or "I experienced kinaesthetic sensations." If the *O*'s indicated any doubt whether a slight movement had been made in the carrying out of an imaginal command, we threw out the results. The columns for sensation, then, represent reports of the experiences aroused by our sensory commands, but at the same time they represent the experiences which were introspectively recognized as sensory; while the columns for image represent reports of the experiences aroused by our imaginal commands, but only those experiences which were recognized introspectively as imaginal.

[6] In the tables, the figures within the columns show the frequencies of report for the rubrics which head the horizontal columns. If, *e.g.*, the number after *O*'s initial is 3, this means that the 30 stimulus-sentences were repeated 3 times for report upon the character in question; 45 experiments for sensation and 45 for image were performed.

(1) *Quality*

TABLE I

QUALITY

	B (3)		Ca (3)		Co (3)		H (3)		St (1)		Su (3)		Z (3)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Du. P.	49	40	26	29	18	33	17		19	11	17	9	53	34	199	157
Br. P.							35						6		41	
Drag							6						2		8	
Sm. P.	10	3	23	3	19	2	34		16	9	31		24	8	157	25
Strain	28		28		35		38		9		20		31		189	
Ache	15		9		5		11				9		1		50	
Lt. P.	12	5	11	29	6	13	9	47			20	38	17		75	132
Total	114	48	97	62	83	48	150	47	44	20	97	47	134	42	719	314

Du. P. = Dull Pressure; Br. P. = Bright Pressure; Sm. P. = Smooth Pressure; Lt. P. = Light Pressure (or Neutral Pressure.)

Ca reported also strain in the image once in the early part of the experiment. Z reported 3 cases of strain and 3 of bright pressure in the images. The following were also reported in early observations: sharp pressure, Z, for image 2, for sensation 4; granular pressure, Z, for image 1, for sensation 1; coolness, Co, for sensation 2; St, for image 1; dizziness (which later was found to be nothing but dull pressure), for sensation, Ca 5; St, 1; Su, 3; for image Su, 2.

We see that the characteristic qualities in kinaesthetic sensations are dull pressure, light pressure, smooth pressure, strain, and ache. These were reported by all *O*'s except St, who reported no light pressure. Dull pressure averages the highest frequency, although the individual reports show that Ca, Co, and H reported the greatest number under strain, and Su the greatest number under smooth pressure. H and Z reported also bright pressure and drag. Bright pressure is experienced only when the *O* is in very good physical condition. Drag is very like dull pressure, and may have been considered qualitatively the same by the other five *O*'s.

The table shows very strikingly the fact that the image is less varied in quality than the corresponding sensations. The headings for quality run thus:

Observer	*Sensation*	*Image*
B	5	3
Ca	5	3
Co	5	3
H	7	1
St	3	2
Su	5	2
Z	7	3

In every case a greater number of qualities belongs to sensation.

Table I shows also the complexity of a perception of movement as compared with the imaginal reproduction of that movement. All the *O*'s except St performed 45 sensory experiments and 45 imaginal experiments on quality. The numbers in the total at the bottom of the table show that the different *O's* reported from 83 to 150 separate qualities in the 45 sensory experiments, while they reported from 42

to 62 separate qualities in the 45 imaginal experiments. When we remember that 45 is the lowest number possible if we have one image for every experiment, it becomes evident that in most cases one image carried the whole meaning of the movement, provided that we take one quality to mean a simple process.[7]

TABLE II

INTENSITY

	B (2)		Ca (4)		Co (4)		H (2)		St (2)		Su (3)		Z (3)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Strong	20		16		16		7		24		15		17		115	
M. St	22		5		3		17		6				21	7	74	7
Mod	11	7	63	40	58	27	22		31	4	28	10	20	18	233	106
M. Wk	8	16					5	10	1			3	14	16	28	45
Weak	13	14	48	45	33	23	25	16	11	12	39	21	6	2	175	133
V. Wk			3	6	3	22		5	3	18		11		3	9	65
Total	74	37	135	91	113	72	76	31	76	34	82	45	78	46	634	426

M. St. = Moderately Strong; Mod. = Moderate; M. Wk. = Moderately Weak V. Wk. = Very Weak.

The following were reported in the early part of the experiments, and were not reported in later observations: kinaesthetic image, strong in intensity, Ca, 1; Co, 7; Z, 2; moderately strong, St, 1; moderate, H, 1; kinaesthetic sensation, very weak in intensity, H, 2; Su, 1; Z, 1.

All the *O*'s but H reported dull pressure for the image; all but St and Z, light pressure; all but H and Su, smooth pressure. The smooth pressure has so low a frequency as compared with the other two qualities that we must doubt its validity as a separate quality for the image (cf. p. 73). We may be fairly certain, then, that the characteristic qualities in kinaesthetic imagery are dull pressure and light pressure; we may say without any doubt that all qualities in the image are "pressury" (a term used by *O*'s in describing the quality of images).

[7] For some observers (H and generally Z) one quality was to all intents and purposes a simple process, but for others it was not. We must not be misled by quality, for even though there is but one quality present, we have no guarantee that the image is not complex. There are still possible variations of intensity and vividness, as well as changes in temporal course. We found, indeed, that quality oftentimes played a surprisingly minor rôle in kinaesthetic experiences. Quality is usually regarded as the individualizing attribute; but our *O*'s were often able to describe the intensive attributes of a sensation or image when they could not describe its quality. Furthermore, the quality of the kinaesthetic images was monotonous in its sameness, and yet the image was varied and interesting because of slight shadings of intensity, or slight changes during its brief temporal course.

The table shows only 42 imaginal qualities reported by Z in 45 experiments. In reality he reported 51 qualities, but the other 9 are included in a footnote to the table, because they are not qualities reported by other *O*'s and were reported by Z only in early experiments.

There is neither strain nor ache in the image, though the kinaesthetic image may mean a movement that would be strainful or achy in sensation.

There were indications that there is a difference in brightness in the qualities of sensation and image. All qualities in the sensations seem to have a certain "liveness" or brightness which the qualities in the images lack. H stated the difference thus: "The quality of the image is dead and static, while the quality of the sensation 'wells up,' has brightness or liveness or sparkle, and is dynamic." There is, of course, always the possibility that an obscure perceptual motive has colored the sensations.

(2) *Intensity*

We find that the intensity of kinaesthetic sensations ranges from strong to weak. The whole intensive scale is represented in all the reports, save that three *O*'s report a few sensations of very weak intensity, while four report none below weak.

The highest frequency of report for B and Z occurred under the rubric "moderately strong;" for Co, Ca, and St under "moderate;" and for H and Su under "weak." Thus, the middle portion of the scale was most favored.

The kinaesthetic image has less range over the intensive scale than the sensation, going only from "moderate" to "very weak." There is one exception to this statement: Z reported 7 images as "moderately strong." Z showed a tendency to estimate all the intensive attributes high. This may have been due to the fact that he "held" his images at first; for the tendency disappeared in the later experiments.

The highest frequency for B's images was in the "moderately weak" group; the highest frequency for Ca's, H's, and Su's images was in the "weak" group; the highest frequency for Co's and Z's was in the "moderate" group. For all observers except Z more than half of all the images reported belong to the lower half of the scale. If we consider the totals at the left of the table, we see that the highest frequency for sensation fell under the "moderate" group, and for image, under the "weak" group.[8]

We may not say, then, that kinaesthetic images are weaker in intensity than kinaesthetic sensations, for some kinaesthetic sensations are weak; but we may say that kinaesthetic images are never strong in intensity, as kinaesthetic sensations often are.[9]

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[8] We cannot expect the individual reports to agree absolutely, for our *O*'s were using subjective scales. The small divergences from the average for the group show, however, that these scales must have been very much alike in all cases. In general, it is not the absolute estimate that we care for, but the relative judgments which show the difference between sensation and image.

We do not have agreement of numbers in the grand totals in the different tables. The characters for report were fractionated, and were repeated a different number of times.

[9] The *O*'s, with further training, confined their reports on intensity of images more and more to the lower part of the intensive scale (cf. p. 73).

(3) *Extent*

TABLE III

EXTENT

	B (2)		Ca (5)		Co (4)		H (2)		St (2)		Su (5)		Z (6)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I
V. Ex.	12		2		8		13				4				39	
Ext.	14		40	13	40		18		10		41		74	12	237	25
M. Ex.	10	2	19	11			7		11	2	29		15	4	91	19
Mod.		4			34	15	6		9	10		3	54	36	103	68
M. Lm.	6	7	8	5	6	8	5	2	1		17	22	1	2	44	46
Lim.	8	9	35	31	1	36		19	5	14	37	37	35	33	121	179
V. Lm.	6	13		2		5		12	6	5		15	6	15	18	67
Total	56	35	104	62	89	64	49	33	42	31	128	77	185	102	653	404

V. Ex. = Very Extended; Ext. = Extended; M. Ex. = Moderately Extended; Mod. = Moderate; M. Lm. = Moderately Limited; Lim. = Limited; V. Lm. = Very Limited.

The following were also reported; kinaesthetic image, very extended, Ca, 2; Co, 1; extended, Co, 2; St, 1; kinaesthetic sensation, very limited in extent, Ca, 2. All of these reports occurred in the early part of the experiments.

The extent of kinaesthetic sensations ranges from very extended to very limited. All *O*'s but one favored the rubric "extended" the exception being St who favored "moderately extended." Twice as many sensations are found in the upper portion of the scale as in the lower.

The extent of the kinaesthetic image varies within smaller range than that of kinaesthetic sensations. To be sure, the table shows that two *O*'s reported a number of their images as "extended." It was in this group of experiments, however, that we discovered the same *O*'s "holding" their images. After we had instructed them that there must be no voluntary holding or building up of the image, the reports of "extended" dropped out almost entirely. In spite of this source of error, we see that by far the greatest number of images fall in the lower part of the extensive scale, and that no images reach the maximum of extent attained by some sensations.

Most of the images reported by B were "very limited;" most of those reported by Ca, Co, H, St, and Su were "limited;" while most of those reported by Z were "moderate." When all the sensations reported by all the *O*'s are totalled, the highest frequency falls under the rubric "extended;" when all the images reported are totalled, the highest frequency falls under the rubric "limited."

We may say, then, that kinaesthetic sensations tend to be extended, while kinaesthetic images tend to be rather limited. We may say also that whereas kinaesthetic sensations are sometimes limited in extent, kinaesthetic images are never maximally extended.[10]

[10] The *O*'s, with further training, agree more and more in their reports upon the extent of the image (cf. p. 74).

(4) *Duration*

TABLE IV

DURATION

	B (2)		Ca (5)		Co (5)		H (3)		St (2)		Su (5)		Z (5)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Long	15		25	35	30		32		15		31		74	14	222	49
M. Lg.	11		39	27	71	20	12		4		47		8		192	47
Mod.	12	10					2	2	15	6		3	24	5	53	26
M. Sh.	14	6	58	8	6	19	2	2		3	17	13	16	12	113	63
Short	4	15		28	5	26	12	34	7	6	34	46	16	27	78	182
V. Sh.			4	2		9		8	3	11		13	5	15	12	58
Total	56	31	126	100	112	74	60	46	44	26	129	75	143	73	670	429

M. Lg. = Moderately Long; Mod. = Moderate; M. Sh. = Moderately Short; V. Sh. = Very Short.

The following reports occurred in the earlier experiments, and dropped out entirely in later experiments: kinaesthetic image, long in duration, Co, 2; H, 1; St, 2; moderately long, H, 1; Z, 1.

The duration of kinaesthetic sensation may be long, medium, or short. The sensations, however, tend to group themselves about the upper half of the scale, more than 50 per cent of all the sensations reported being above moderate.

The highest frequency fell under the heading "long" for B, H, and Z; under "moderately long" for Co and Su.

The kinaesthetic image, according to the table, may be anywhere from "moderately long" to "very short" in duration. This statement excludes the reports of Ca and Z, who in the first 3 repetitions of this group of experiments, "held" their images. After the instruction to let the image run its course naturally, the reports of "long" dropped out. For all *O*'s but Ca, more than half of all the images reported are in the lower part of the scale.[11]

As to highest frequencies, we find the greatest frequency occurring under the rubric "short" for all *O*'s except Ca. In the totals, the highest frequency is under "long" for sensation, and under "short" for image.

(5) *Vividness*

TABLE V

VIVIDNESS

	B (2)		Ca (3)		Co (3)		H (3)		St (1)		Su (3)		Z (3)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I
V. H.					5	6	2	3			2	9			9	18
High	29	10	8	15	18	23	43	35	24	10	16	24	27	24	165	141
M. H.	13	16	17	10	12	1	6	1	3	9	13	6	12	16	76	59
Mod.	9	15	12	18	21	5	5	3	6	5	17	5	29	8	99	59
M. Low	14	2	23	4			9				2		24	3	72	9
Low	13	2	25	5	14	10	21	4	3	3	21		15	4	112	28
Total	78	45	85	52	70	45	86	46	36	27	71	44	107	55	533	315

V. H. = Very High; M. H. = Moderately High; Mod. = Moderate; M. Low = Moderately Low.

In an early experiment, Su reported one case in which an image was of a low degree of vividness.

[11] With further training the *O*'s confined their reports entirely to the lower part of the durative scale (cf. p. 75).

We find that the vividness of kinæsthetic sensations ranges from high to low. The sensations generally share their vividness with other members of the sensory complex, and are, therefore, not of the highest degree of vividness. The sensations in a perception of movement reach the highest degree of vividness only when they demand attention because of their quality (ache or strain), or their high intensity.

Most of the sensations reported by B, H, and St were "high" in vividness; most of those reported by Co and Z were "moderate;" and most of those reported by Ca and Su were "low." For Ca, Co, Su, and Z there is a pretty even distribution between the three rubrics of "high," "moderate," and "low."

The kinaesthetic image makes up in vividness what it lacks in the other attributes. Comparatively few images were reported "low" in vividness. In nearly all these cases, the lack of vividness was due to the occurrence of a visual image along with the kinaesthetic image. Co had more images of a low degree of vividness than any other *O*; she always reported, in such instances, "The kinaesthetic image was complicated by a visual image." Ca and B had also visual accompaniments to their kinaesthetic imagery, in which cases the vividness of the kinaesthesis varied from "moderate" to "low."[12]

The highest frequency occurred under the heading "high" for Co, H, St, Z, and Su; under "moderately high" for B; under "moderate" for Ca. When all the sensations reported are totalled, the highest frequency comes under the rubric "high," just as the total for all images shows as highest frequency the rubric "high."

The kinaesthetic image, then, is of a high degree of vividness. It has the advantage over sensation in its simplicity and uniformity; it has a chance to stand alone in consciousness for a brief time. While kinaesthetic sensations may be as often low in vividness as high, kinaesthetic images, unmixed with imagery from other sense departments, are never low.

(6) *Locality*

TABLE VI

LOCALITY

	B (2)		Ca (3)		Co (3)		H (3)		Su (4)		Z (4)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Deep	25	10	50	7	9	3	56		77	30	83	18	300	68
M. Deep	7	5	18	10	57	12	21		11	2	41	33	155	62
M. Sup	12	3	8	10		2	46		9	4	2	1	77	20
Sup	16	14	6	28	16	29	5	45	30	2	55	25	128	143
Total	60	32	82	55	82	46	128	45	127	38	181	77	660	293
Def	23	16	41	34	10	29	13	35	54	13	61	8	202	135
M. Def	11	4	22	10	43	10	42	8	18	12	53	35	189	79
Indef	22	18	15	4	28	8	47		45	13	66	32	223	75
Total	56	38	78	48	81	47	102	43	117	38	180	75	614	289

M. Deep = Moderately Deep; M. Sup. = Moderately Superficial; Sup. = Superficial; Def. = Definite; M. Def. = Moderately Definite; Indef. = Indefinite. B reported 9 images which were localised "outside;" Su reported 19 images as "not localised."

[12] Where the visual image acted as a distraction, it perhaps would have been better to count the experiment unsuccessful. We have not done this, for the disturbance seemed to affect only the reports on vividness. We have, therefore, included everything reported by all our *O*'s.

The depth of kinaesthetic sensation seems to be correlated with its quality. Dull pressure is deep or moderately deep; smooth pressure is deep or moderately deep; strain is more superficial; light pressure is superficial. The highest frequency of report for all *O*'s except Co was "deep;" the highest frequency for Co was "moderately deep."

The superficially localised sensations are, as a rule, definite in localisation; the deep sensations are sometimes quite definite, at other times indefinite. The highest frequency of report fell under the heading "definite" for B, Ca, and Su; under the heading "moderately definite" for Co; and under "indefinite" for H and Z: yet the highest frequency for depth, it will be remembered, came under "deep" or "moderately deep" for all these *O*'s, a fact which shows the difficulty of trying to correlate depth and definiteness. If we consider our total numbers, however, we find the highest frequencies coming under the rubrics "deep" and "indefinite."

The reports upon depth of the kinaesthetic image do not agree among the *O*'s. The highest frequency for B, Ca, Co, and H was "superficial;" for Z, "moderately deep;" for Su, "deep." Here no part of our scale for depth is favored by all *O*'s. B perceived some images as being outside the body, either just touching the skin or entirely separate from the body. Su reported 19 images which were so indefinite that she called them cases of "non-localization." They were unequivocal in reference; they *meant* that she was making the movement in imaginal terms, but they did not seem to be localized in the body.[13]

The images were most often definite in localization for Ca, Co, and H; indefinite for B; and moderately definite for Z. In the totals, we have our highest frequencies under "superficial"[14] and "definite."

Our study of locality reveals a greater diversity among *O*'s than we found in our study of the attributive characters. This is to be expected, for here we are dealing with perception. The image, perhaps because it was a surface-like feel, was perceived by most *O*'s as being at or near the surface. Yet the highest frequency of report for quality came under the heading of dull pressure for B, Ca, and Co, three of the four *O*'s whose highest frequency of report upon locality was "superficial." Again, Su's highest frequency for quality came under the heading of light pressure, while the locality of her images was most often deep. Again, we might be tempted to suppose that the image was localized at or near the surface because it was perceived, generally speaking, as flat and thin, like the cutaneous qualities. And yet Su and Z reported a great many images which were perceived as "flat," but were localized as deep or moderately deep. We can only say, then, that although quality and bidimensionality are probably conditions of the perception of depth in the kinaesthetic image, there are other important conditions which our reports did not reveal.

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[13] There is an analogy to this indefiniteness of localization in the visual field. D. Katz characterizes the film-color as "indefinite" in localization; "Die Erscheinungsweisen der Farben und ihre Beeinflussung durch die individuelle Erfahrung," 1911, 73 ff.

[14] Superficial does not always mean "on the surface;" it may mean "skin-deep" or "just underneath the skin."

(7) *Pattern*

TABLE VII

PATTERN

	B (2)		Ca (2)		Co (3)		H (3)		Su (3)		Z (3)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Broad to narrow	8		3	3	1	2			14		2		28	5
Longer than broad	12		3	2	3	3	11		6		3		38	5
Spot to streak	2	15	3	2	21	19	8		6	23	18	7	58	66
Irreg. patch	3	3							12		7		22	3
Small spot				5	2	4		29	4	4	7	19	13	61
Qual. diff's			3		1				4		2		10	
Int. and viv. shadings	5	8	1		4	10			6	5	2		18	23
Total	30	26	13	12	32	38	19	29	52	32	41	26	187	163

Irreg. = Irregular; Qual. diff's = Qualitative differences; Int. & viv. shading = Intensive and vividness shading.

Su and Z reported also spots which became "rayed" on all sides, five times and once respectively; H reported a sharp, regular outline for the image 16 times; Z reported a "mosaic of spots" 7 times for sensation and twice for image (he could not decide whether it was qualitive or intensive.)

The totals in this table do not equal those in the former tables, because often there was no observable pattern in the kinaesthetic experience.

Kinaesthetic sensory complexes show great diversity of pattern. There were reported, by all observers but H, "masses" which ran out to points in pyramidal fashion; there were indefinitely outlined "patches," sometimes "bulky," sometimes "flat," and usually "longer than broad;" there were "spots or lumps" which stretched out to "bands" during their course; there were small spots which remained unchanged during their course, for all but B and Ca. Dimensionality did not come into all reports, but where it appeared, the kinaesthetic sensations are mostly tridimensional. The *O*'s who did not report upon it were questioned at the end of the experiment, and stated that so far as they could remember most of their kinaesthetic sensations had been in three dimensions.

The qualities showed characteristic patterns. Strain was perceived as "stringy" or pointed; dull pressure as "massive" and "bulky," and often "elongated;" light pressure as "patchy," "sheet-like," or "flat." The patterns themselves had attributive differences within them: "nuclei" of dull pressure, strain, or smooth pressure, with "fringes" of light or bright pressure (for H and Z); "bands" of dull pressure with pointed ends of strain (for Ca, Co, and Su). Intensive and vivid variation, such as more intense or vivid center, point, or end, or "strips" or "cores" or "mosaics" of greater intensity or vividness, were reported by all.

The kinaesthetic images show more uniformity in pattern than the kinæsthetic sensations. Their pattern consisted almost entirely of small spots, which sometimes remained unchanged during their brief temporal course, and at other times ran out temporally to small streaks. Images, too, were bidimensional, or of very slight thickness.

For all *O*'s the qualitative patterning of the images was uniform. For some *O*'s (Ca and H) the images were uniform in all the attributes; for others there were at times intensive and vivid variations within the pattern: a less intense border which was perceived as

"fringed" if the quality was dull pressure; as "fuzzy," "feathery," or "like a bit of down, only smoother," if the quality was light pressure; a greater intensity or vividness at one end or side; or a wave of vividness which travelled over the image (for Ca and Su).

(8) *Temporal Course*

TABLE VIII

TEMPORAL COURSE

	B (4)		Ca (2)		Co (3)		H (4)		Su (3)		Z (3)		Total	
	S	I	S	I	S	I	S	I	S	I	S	I	S	I
Increase in intensity	22	20	29	7	24	15	80		29	3	39		223	45
Increase in extent	12	8	10	7	35	29	47		29	23	35	5	168	72
Increase in vividness	18	8	13	8	6	1	5		10	11	3		55	28
Decrease in intensity	31	17	18	2		2	14		8				71	21
Decrease in extent	6		5	2	2		3						16	2
Decrease in vividness	28			2	3				4		11		46	2
Addition of quality	42		6		20		75		29		42		214	
Subtraction of quality	37		7		6		31		7		16		104	
No change		22		13				52		17		40		144
Total	196	75	88	41	96	47	255	52	116	54	146	45	897	314

Kinaesthetic sensory complexes undergo attributive as well as processual changes in temporal course. All the *O*'s reported increases in intensity, extent, and vividness, while some reported decreases in intensity, extent, and vividness. Processual changes were reported by all. A perception of movement might begin, *e.g.*, with dull pressure, to which would be added strain, and perhaps ache. The ache might be very brief, leaving the strain and dull pressure. Then the strain would drop out, perhaps, leaving the dull pressure. Addition of quality was more frequent than subtraction of quality for all *O*'s except Ca.

Kinaesthetic images or imaginal complexes undergo very little attributive change and no processual change during their course. Oftentimes the image remained absolutely unchanged (for all *O*'s but Co). Increase in some one of the intensive attributes was common with B, Ca, Co, and Su; most often in intensity for B and Ca, most often in extent for Co and Su. All of H's images were without pattern or temporal course; only 5 of Z's images had temporal course. Decreases in the intensive attributes were rarely reported by anyone but B. No processual changes were reported. An image never adds to itself a new process. It simply flashes in and out, with now and then a second image following it, but entirely separate from it.

(9) *'Body' or Collocation of Attributes*

Kinaesthetic sensations have more "body" than images. The intensive attributes in the sensory integrations are of varying degree. If a sensation is of very weak intensity, and of very limited extent, it will be, in all probability, somewhat long in duration. A haphazard search through reports on sensation shows the following combinations:

Observer	Intensity	Extent	Duration
Co	weak	very extended	long
	strong	mod. limited	long
H	weak	mod. limited	mod. long
	mod. strong	extended	short
Su	weak	extended	mod. short
	weak	mod. limited	long
Z	weak	mod. extended	mod. short
	moderate	extended	long

The majority of reports on image for these 4 observers show integrations of this sort:

Intensity	Extent	Duration
weak	limited	short
mod. weak	very limited	very short
very weak	very limited	very short

Although there were reports of sensations which were weak, limited, and short, there were never reports of sensations as very weak, very limited, very short. Yet all *O*'s gave many reports of images which were very weak, very limited, and very short.[15]

Summary

Kinaesthetic sensation and kinaesthetic image compare thus:

(1) The qualities in kinaesthetic sensation are dull pressure, light pressure, bright pressure, smooth pressure, strain, and ache. The qualities in kinaesthetic image are all 'pressury,' dull pressure, light pressure, and possibly smooth pressure (cf. p. 73).

(2) The intensity of kinaesthetic sensation may be anywhere on the intensive scale from strong to weak. The intensity of the kinaesthetic image is always comparatively weak.

(3) Kinaesthetic sensations range all over the extensive scale from near zero to maximum, with a tendency however to group themselves about the upper part of the scale. The extent of the kinaesthetic image is for the most part limited, and it never reaches the maximum of extent attained by some sensations.

(4) The duration of kinaesthetic sensation is, in most cases, relatively long. The duration of the kinaesthetic image is

[15] Cf J. Lindworsky, "Wahrnehmung und Vorstellung," *Zeits. f. Psych.*, LXXX, 1918, 215 ff.; C. Stumpf, "Empfindung und Vorstellung *Abh. d. kgl. preus. Akad. d. Wiss.*, 1918. These articles reached us, unfortunately, too late for more than a mention at this place. See also E. B. Titchener, Thought-Processes, 1909, 20 f., 214; and for evidence of 'holding' in the sphere of sensation, R. T. Holland, *Journ. Exp. Psych.*, iii., 1920, 312 ff.

relatively short; it never reaches the highest part of the durative scale.

(5) The vividness of kinaesthetic sensations ranges from high to low. The vividness of the kinaesthetic image, on the other hand, is always high, unless the image is accompanied by imagery from other sense-departments.

(6) The locality of kinaesthetic sensations ranges from deep and indefinite to superficial and definite, with a tendency to be deep and indefinite. Dull pressure and smooth pressure are deep; strain and ache, more superficial; and light pressure, superficial. Kinaesthetic images are localized definitely by most *O*'s on or near the surface. They show no correlation between quality and depth or definiteness.

(7) Kinaesthetic sensory complexes show various types of pattern: 'pointed' or 'stringy' for strain; 'bulky' and 'roundish' or 'elongated' for dull pressure; and 'flat' and 'patchy' for light pressure. There are qualitative differences and intensive and vivid shadings within the sensory pattern. The sensations are for the most part tridimensional. Kinaesthetic imagery shows always the same pattern, a small spot, which sometimes increases temporally to a streak. It is uniform in all attributes for some *O*'s; it has intensive shadings for others. The images are most often bidimensional.

(8) The kinaesthetic sensory complexes show attributive as well as processual changes in temporal course, increasing and decreasing in all the intensive attributes, and changing in quality by addition and subtraction. Kinaesthetic imagery has very little, if any, temporal course, being generally too brief for change. Cases in which the image undergoes a slight increase in extent or intensity are the only exceptions to this statement.

(9) Kinaesthetic sensations have more 'body' than kinaesthetic images. What the sensation lacks in any one intensive attribute it makes up for in some other intensive attribute; the image may be poor in all the intensive attributes save vividness.

II. Resident and Projected Kinaesthetic Imagery

We have now compared kinaesthetic memory-image with simple kinaesthetic perception, and have been able in this way to compare kinaesthetic sensation with the kinaesthetic simple image aroused under certain (*i.e.*, memory) conditions. We have, however, no reason to suppose that we have exhaustively described 'the' kinaesthetic simple image. Under other conditions of arousal, the image may show in other

phenomenal modes. In particular, there may (we thought) be various attributive differences between the resident kinaesthetic image of memory and the projected kinaesthetic image of empathy, if indeed we have any psychological right to speak of a 'projection' of kinaesthesis at all. This, then, is the point upon which our further experimentation is directed.

We made out a new list of paired commands for the arousal of kinaesthetic imagery, half of them representing situations which called for usual, ordinary, familiar movements, similar to those of the preceding experiments, the other half representing situations in which there were unusual movements.

The experimental procedure was the same as before. The instructions, too, were the same. The work began at the end of October, and continued throughout the next four months. Two of our *O*'s, Ca and St, left the university; the remaining five served in this second period of our work.

Experiment III

We performed about 50 preliminary experiments, in order that our *O*'s might attain a fair degree of stability of attitude. We found that now, when the situations were more complex, the visually minded *O*'s realized the situations for the most part in visual terms, in spite of the instructions. We decided, therefore, to change the wording of our commands, making them read, "Feel: Tantalus standing in water, trying in vain to drink," instead of "Think of: Tantalus standing in water, etc." We explained that by "feel" we meant "realize kinaesthetically." This slight change in the stimuli effected wonders in the results. Visual imagery became unimportant, while the kinæsthetic imagery, in many cases, carried the whole meaning of the situation.

Experiment IV

We were now ready to begin the main part of the experiment. We made out fifteen paired commands, one member of every pair referring to a usual situation, the other member referring to an unusual situation.[16] Again we fractionated the characters to be reported upon, asking in Group I for quality, intensity, and extent; in Group II. for duration, vividness, and locality; in Group III. for pattern and temporal course. We repeated every group, so that we had 60 experiments for every group.

[16] Examples of the stimuli are: "Feel: yourself running downstairs." "Feel: an acrobat walking a tight rope." "Feel: Laocoon struggling in the coils of the serpent." "Feel: yourself stooping to pick up a pencil." The colon after the word "feel" indicates that a short pause was made after this word in reading the stimuli.

Results

We found that the kinaesthetic images aroused by our stimuli may be classified under two main headings: (1) resident kinaesthesis, which is like that studied in the first part of the paper, the kinaesthetic imagery which ordinarily is referred to oneself; and (2) projected kinaesthesis, the kinaesthetic imagery which is projected outward, and is referred ordinarily to someone else or something else.

The *O*'s came upon the projection gradually. H, *e. g.*, said: "That kinaesthesis was not in me; it belonged to the visual image." "The kinaesthesis did not relate to myself; it related to someone else." And later (of an image aroused by the stimulus, "Feel: a farmerette pitching hay"), "The kinaesthetic image belongs to the farmerette, it is a kind of empathy."

Z, after reporting for some time the fact that some of his kinæsthetic images did not belong to himself, but to the person referred to in the stimulus, said: "It is a kind of projection."

Su reported at first thus: "The kinaesthetic image belonged to myself; then it was projected into an imaginary figure." And for another situation, relating to Tantalus trying in vain to drink: "The imagery was in me and then in Tantalus, but somehow it was transferred from the right side of my neck to the left side of Tantalus, who was out in front and facing me." Later, Su reported: "It seems as if the kinæsthesis is lifted bodily out of me and put into someone else; then it changes attributively. Sometimes, it sinks back into me at the end of the report." Still later Su reported projection without having first noted the beginning in resident kinaesthesis.

Co reported for the stimuli referring to the self: "The kinaesthetic image was in me," but for the stimuli referring to someone else: "The kinaesthetic image was not in me, but went with the visual image to make up the situation."[17]

Finally, B said of a projected kinaesthetic image: "It is as if it were fully formed out in space, and happened to catch my attention." And again: "It is fully formed like an object out there to be looked at."

Thus, all the *O*'s came, rather slowly but certainly, to a realization that some of their images were resident, while others were projected out into a foreign object.

We found, however, that before the resident and projected kinæsthesis could be differentiated clearly, we had to break up an attitude which some of the *O*'s had carried over from the work on sensation and image. There, it will be remembered, because of the mistakes of several *O*'s who "held" or "built up" their images, we had warned all the *O*'s against a shift from the passive or receptive attitude towards sensation to an active or constructive attitude toward their imagery. When their attention was thus called to the change, they realized that the images which were taken passively, as the sensations were, did not persist, but were sudden and brief. It was then natural to keep the passive attitude, and to be content to report upon the brief "flash" of kinaesthesis as it came and passed.

[17] Two of the *O*'s always had visual accompaniments to their projected kinaesthesis; three had nothing but kinaesthetic imagery, the whole imaginal figure and the meaning of the situation being carried in terms of dull pressures, light pressures, bright pressures, strains and aches.

But here where we are working upon a differentiation within the realm of imagery itself, the *O*'s *must be able to shift attitudes.* The projected kinaesthesis begins as a brief flash of resident kinaesthesis, which is then projected out into a foreign object, and becomes stabilized as the attitude shifts from passive to active. After an *O* has become habituated to the active attitude of projected kinaesthesis, the beginning bit of resident kinaesthesis may fail to be observed. Before such habituation, however, the resident kinaesthesis and the projected kinaesthesis may alternate, making the experience mixed. If, now, the *O* is accustomed to the passive attitude, he will seize upon the fleeting resident image, and will begin his report immediately after this 'flash' of experience, instead of waiting for 'stabilization.' He will thus report upon resident kinaesthesis partially changed, perhaps, by admixture of a bit of projected kinaesthesis.[18]

As soon as the *O*'s became familiar with the two attitudes, we asked them to alternate the two. When we instructed them to take an active attitude toward the stimuli which normally gave resident kinaesthesis, they reported that the image could not be made to persist, but slipped away, repeated itself, and produced a quick succession of images of like patterns. This shows that true 'stabilization' was not possible. When we instructed the *O*'s to take a passive attitude toward the stimuli which normally gave projected kinaesthesis, they reported different patterns with each succeeding 'flash' of experience, until in the end all the separate patterns returned, became stabilized, and persisted as a complete situational image. This shows that stability was necessary here for a complete realization of the experience. In these cases, neither the 'flash' nor the 'stabilization' was quite natural: the 'flash' was not the totally involuntary thing that normally occurs in resident kinaesthesis, and was longer in time; and the 'stabilization' was not complete as in projected kinaesthesis; there were gaps in time, in which there was no process. The *O*'s thus discovered that, although either attitude is possible with any stimulus, the active attitude is natural for projected kinaesthesis, as the passive attitude is natural for resident kinaesthesis. They reported also that the active attitude seems to grow naturally out of the passive, as stability grows naturally out of a beginning 'flash.'[19]

From the statements of the *O*'s in characterizing the two attitudes, we have gleaned the following differences between the two. The attitude in projected kinaesthesis is the perceptive attitude; the situation is objectified, and the *O* contemplates it as he would a landscape; the report upon the imagery is more like an *Aussage*-report than a scientific description; the attitude is correlated with imagery which is so full that it is not all clear at once, imagery which is persistent and unchanging as the different parts become vivid in turn for report; the attitude is active, exploratory, detached. The attitude in resident kinaesthesis is the sensory attitude, the same as that of the earlier part of our work; the *O* experiences the imagery as he would a sensation or an after-image; the report is the ordinary laboratory

[18] The two terms 'flash' and 'stabilization' were used by an *O* in distinguishing the experiences under the two attitudes.

[19] It may be that some of Perky's critics have been misled by failure to recognize the different attitudes. Their *O*'s may not have waited for stability, but may have reported upon the first brief 'flash' of experience; and may then have called this an 'image of imagination,' when in reality it was a 'memory image' from which an 'image of imagination' might (with shift of attitude) have developed.

description; the attitude is correlated with imagery which is all clear at once, and is fleeting and changing; the attitude is passive, receptive, realizing.

A. Resident and Projected Kinesthetic Imagery Compared

The following tables, arranged upon the same plan as those for the comparison of sensation and image, show the difference in the psychological pictures of resident (R) and projected (P) kinaesthesis.

(1) *Quality*

TABLE IX

QUALITY

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
Du. P.	30	29	30	26	85	1	22	9	41	18	208	83
Brt. P.	11				34		18		1		64	
Drag					2				2		4	
Sm. P.					13		5		1		19	
Strain	2		16		45		3		10		76	
Ache	1		4		21		2		6		34	
Lt. P.	1	26	4	7	16	43	32	32	26	11	66	119
Total	45	55	54	33	216	44	82	41	87	29	471	202

P = projected kinaesthetic imagery; R = resident kinaesthetic imagery.
Du. P. = Dull Pressure; Brt. P. = Bright Pressure; Sm. P. = Smooth Pressure;.
Lt. P. = Light Pressure (or Neutral Pressure.)

Projected kinaesthetic imagery is qualitatively very much like sensory kinaesthesis. Dull pressure, strain, ache, and light pressure are common. Bright pressure occurs much more often in the projected imagery than in the sensory complexes; only one *O* failed to report it here, while only two *O*'s found it in actual sensations.[20] The existence of smooth pressure in projected kinaesthesis is doubtful; only three *O*'s reported it, and that in a comparatively small number of cases. Drag is not common in projected kinaesthesis.

From 4 to 7 different qualities were reported in projected kinaesthetic imagery. Dull pressure has the highest frequency in the average, and for the individual *O*'s with the exception of Su.

Resident kinaesthetic imagery has but two qualities, dull pressure and light pressure. In the preceding part of our work we were in doubt whether to include smooth pressure in the list of qualities for

[20] A 'textural' difference is reported between the bright pressure of sensation and the bright pressure of projected kinaesthesis. In sensation, it is 'sparkling' like a liquid upon which a light is shining; in projected imagery, it is misty, like a halo or a sun-lighted cloud.

imagery. Since none of the *O*'s, after further training, reported it, we may conclude that it is not characteristic of resident kinaesthetic imagery (cf. p. 59). Light pressure has the highest frequency in the average, although individual *O*'s gave the highest frequency to dull pressure.

Here, where our situations are more complex, a single image-process did not always stand for the whole situation. Often the reports showed an imaginal complex made up of a number of simple processes following one another in quick succession, and differing from one another very slightly. There were never two such processes present at once, as there were in the projected kinaesthesis and in sensory kinaesthesis.

(2) *Intensity*

TABLE X

INTENSITY

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
Strong	14		17		33		8				72	
M. St.					23		5		5		33	
Mod.	5	19	25	12	33		21	3	32	16	116	50
M. Wk.	5	7			5	2	11	12	37	15	58	36
Weak	10	16	8	17	26	29	27	11	17	3	88	76
V. Wk.	8	13	4	4	14	10	14	14	5		45	41
Total	42	55	54	33	134	41	86	40	96	44	412	203

M. St. = Moderately Strong; Mod. = Moderate; M. Wk. = Moderately Weak; V. Wk. = Very Weak.

The intensity of projected kinaesthetic imagery ranges from strong to weak, with the highest frequency of the average coming under 'moderate' as in the sensory complexes. The highest frequency for B falls under the rubric 'strong;' for Co, under 'moderate;' for Su, under 'moderately weak.'

The intensity of resident kinaesthetic imagery ranges from moderate to very weak, with the highest frequency averaging 'weak.' The highest frequency for B and Z occurs under 'moderate;' for Co and H, under 'weak;' for Su, under 'very weak.'[21]

[21] We see that the *O*'s have ceased to report any resident kinaesthetic images in the upper half of the intensive scale (cf. p. 60). Training undoubtedly had an effect here; but there is a more important factor to be considered, namely, the fact that the *O*'s had no absolute criterion. It was natural, then, that the resident imagery should be comparatively weaker when compared with projected kinaesthesis, which represented large and complicated movements, than it was when compared with simple sensory movements, such as we used for stimuli in the earlier experiments.

(3) *Extent*

TABLE XI

EXTENT

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
V. Ex.	2		7		33		6		1		41	
Ext.	3				22		14				47	
M. Ex.	20				29		25		3		77	
Mod.	2	16	31	7			11	3	39	6	83	32
M. Lm.	4	11			13		12	7	33	11	62	29
Lim.	5	10	16	30	6	9	15	16	12	12	54	77
V. Lm.	6	16	1		4	21	3	14	10	5	24	56
Total	42	53	55	37	107	30	86	40	98	34	388	194

V. Ex. = Very Extended; Ext. = Extended; M. Ex. = Moderately Extended; Mod. = Moderate; M. Lm. = Moderately Limited; Lim. = Limited; V. Lm. = Very Limited.

Projected kinaesthesis, like sensory kinaesthesis, varies in extent from very extended to very limited. The highest frequency comes under the heading 'moderately extended' for B and Su; under the rubric 'moderate' for Co and Z; under the rubric 'very extended' for H.

According to the table, the resident kinaesthetic image never goes beyond the middle part of the extensive scale.[22]

The highest frequency of report is 'limited' for Co, Su, and Z; and 'very limited' for H. The highest frequency in the totals comes under the heading 'moderate' for projected kinaesthetic imagery; the highest frequency in the totals comes under the heading 'limited' for resident kinaesthesis. Thus all the resident images are found in the lower half of the scale, while over 50 per cent of the projected images are found in the upper half of the scale of extent.

(4) *Duration*

TABLE XII

DURATION

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
Long.	32		48		175		92		117		420	
M. Lg.												
Mod.				1								1
M. Sh.		13		4				8		6		28
Short.		6		24		1		11		5		42
V. Sh.		17		9		49		14		19		99
Total	32	36	48	38	175	50	92	33	117	30	420	170

M. Lg. = Moderately Long; Mod. = Moderate; M. Sh. = Moderately Short; V Sh. = Very Short.

[22] Training *plus* a larger relative scale for comparison has again levelled out the discrepancies which we found in the earlier reports (cf. p. 61).

Projected kinaesthetic images are always long in duration. The whole image comes fully formed, and there is no addition or subtraction of process.

Resident kinaesthetic images are always short in duration. The highest frequency for all *O*'s falls under the rubrics 'short' and 'very short.' The highest frequency in the totals comes under the rubric 'very short.'[23]

(5) *Vividness*

TABLE XIII

VIVIDNESS

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
V. H.	6	4	1	7	20	43	2	4	1	15	30	73
High	9	9	19	14	56	6	25	16	2	10	111	55
M. H.	13	19	12	11	7		33	8	20	3	85	41
Mod.	5	5	8	1	6		19	5	33	2	71	13
M. Low	2				30				30		62	
Low			6	1	60		13		33		112	1
Total	35	37	46	34	179	49	92	33	119	30	471	183

V. H. = Very High; M. H. = Moderately High; Mod. = Moderate; M. Low = Moderately Low.

The vividness of projected kinaesthesis is divided evenly between high and low. Not all of the projected experience can be in the focus of attention at one time. The highest frequency of report falls under the heading 'moderately high' for B and Su; under 'high' for Co; and under 'low' for H.

The vividness of resident kinaesthesis ranges from very high to moderate. Most of B's images were 'moderately high;' most of Co's and Su's were 'high;' most of H's and Z's were 'very high.' The greatest number of images in the total falls under the heading 'very high.'

[23] The table for duration shows markedly the relativity of the subjective scale. In the earlier experiments, most of the images were 'short' in duration, but here by far the greatest number of images are 'very short' in duration (cf. p. 62). We can account for the change in report by the fact that the projected imagery is (objectively) very long in duration.

(6) *Locality*

TABLE XIV

LOCALITY

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
Deep	17	10	13		85		21	8	37	1	173	19
M. Deep	8	9	31		53		16	4	56	3	164	16
M. Sup.	3	3	1	15	38	5	21	6	18	10	81	39
Sup.	7	8	2	19		44	32	5	9	16	50	92
Total	35	30	47	34	176	49	90	23	120	30	468	166
Def.	8	23	9	29	65	46	23	5	3	19	108	122
M. Def.	10	8	21	4	41	6	24	7	41	9	137	34
M. Ind.		1			23		4	11	38	1	65	13
Indef.	15	3	18	1	49		39		38	1	159	5
Total	33	35	48	34	178	52	90	23	120	30	469	174

M. Deep = Moderately Deep; M. Sup. = Moderately Superficial; Sup. = Superficial; Def. = Definite; M. Def. = Moderately Definite; M. Indef. = Moderately Indefinite; Indef. = Indefinite.

B reported 2 sensations and 5 images localised "outside;" Su reported 9 images as 'not localised."

Generally speaking, projected imaginal kinaesthesis, like sensory kinaesthesis, is localized as deep and indefinite. There is, however, much individual variation. As to depth, the highest frequency for B and H is under the rubric 'deep,' for Co and Z, under 'moderately deep;' for Su, under 'superficial.' As to definiteness, the highest frequency for B and Su comes under the rubric 'indefinite;' for Co and Z, under 'moderately definite;' for H, under 'definite.'

Resident kinaesthetic images are most often localized as superficial and definite. Most of Co's, H's, and Z's images were 'superficial' and 'definite;' most of B's were 'deep' and 'definite;' most of Su's were 'deep' and 'moderately indefinite.'

We find very few images in resident kinaesthesis which are indefinite in locality, although earlier (p. 63) we had a fair proportion of images reported under this rubric. We know of no way to account for the change except by the effect of training. One *O* said of resident kinaesthetic images: "They are so definitely localized that I could pin a ribbon on them."

We find, as before, cases of non-localization of resident images.

(7) *Pattern*

The pattern of projected kinaesthesis is even more varied than that of sensory kinaesthesis. All *O*'s reported 'long strips' of bright pressure or dull pressure; 'strings' of strain; masses, longer than broad, of dull pressure; irregular patches of light pressure or bright pressure; small spots of dull pressure or light pressure. The bright pressure was sometimes characterized as 'hollow,' like a short tube

TABLE XV

PATTERN

	B (2)		Co (2)		H (2)		Su (2)		Z (2)		Total	
	P	R	P	R	P	R	P	R	P	R	P	R
Strip	5	12	3	24	7		4	16	24	16	43	68
Longer than broad	27		18		92		31	6			168	6
Irreg. Patch	3		5		5		43		10		66	
Spot		9		7	50	52	28	16	51	11	129	95
Qual. diff's			13		104						117	
Int. and Viv. shadings	4	11	22	16	121		49	16	96	7	292	50
Def. outline				4		52	9				9	56
Indef. outline	1		14				6				21	
Total	40	32	75	51	379	104	170	54	181	34	845	275

Irreg. patch = Irregular patch; Qual. Diff's = Qualitative differences; Int. and Viv. shadings = Intensive and vivid shadings; Def. outline = Definite outline; Indef outline = Indefinite outline.

The following were also reported: "hollow pattern" for Projected Kinaesthesis, 10 (Su), 1 (B); "mosaic of spots" for Projected Kinaesthesis, 20 (Z).

or 'band-box.' This is a pattern which did not occur in sensory kinaesthesis. As in sensory kinaesthesis, so in projected kinaesthesis there were qualitative differences within the patterns, as well as intensive and vivid shadings, characterized as 'striped,' 'mosaics,' 'wrinkled,' 'spotted,' or 'fringed.' The projected patterns were often very indefinite in outline. They were both tridimensional and bidimensional. It is noteworthy that the frequency of report under every heading is much larger for the projected kinaesthesis than it was for the sensory kinaesthesis (p. 65). It is obvious that this difference is to be explained by the fact that the patterns in projected kinaesthesis persist unchanged while the *O* explores them, whereas the patterns in sensory kinaesthesis are in constant flux, and must be caught 'on the wing' for report.

The resident kinaesthetic images, like the kinaesthetic images of the earlier experiments, are characterized generally as small spots, which somtimes remain unchanged and at other times run out temporarily to streaks. Again we had no qualitative differences reported, but quite often intensive and vivid differences, such as "fringes" or "fuzzy" borders. As opposed to the projected kinaesthesis, the resident kinaesthesis is definitely outlined and, for the most part, bidimensional.

(8) *Temporal Course*

Projected kinaesthetic imagery shows no change in time. The imagined situation, made up entirely of kinaesthetic imagery, or supplemented by visual imagery, remains fully formed out in space, like an object at which we are looking, so that the *O* reports from the actual (imaginal) perception.

Resident kinaesthetic imagery comes more suddenly than projected imagery, and remains only a brief time, a time too brief to allow of any change for some *O*'s, but long enough for others to permit a slight increase in intensity or extent. The resident kinaesthetic images pass so quickly that the *O* must report them from memory.

SUMMARY

Projected and resident kinaesthetic imagery compare thus:

(1) The qualities in projected kinaesthesis are dull pressure, light pressure, bright pressure, strain, and ache. The qualities in resident kinaesthetic imagery are dull pressure and light pressure.

(2) The intensity of projected kinaesthesis ranges from strong to weak. The intensity of resident kinaesthesis ranges from moderate to weak.

(3) The extent of projected kinaesthesis ranges from maximum to near zero. The extent of resident kinaesthesis ranges from moderate to near zero.

(4) The duration of projected kinaesthesis is always long. The duration of resident kinaesthesis is always short.

(5) The vividness of projected kinaesthesis ranges from high to low. The vividness of resident kinaesthesis ranges from very high to moderate.

(6) The locality of projected kinaesthesis varies from deep and indefinite to superficial and definite, with a tendency toward depth and indefiniteness. The locality of resident kinaesthesis tends to be superficial and definite.

(7) Projected kinaesthesis shows various types of pattern: 'strips,' 'masses,' 'patches' and 'spots.' These patterns have qualitative differences and shadings of intensity and vividness. Both two and three dimensions are common. The resident kinaesthesis is unvaried in pattern, being ordinarily a spot which may run out temporally to a streak. It sometimes has slight shadings of intensity or vividness. It is most often bidimensional.

(8) Projected kinaesthesis shows no change throughout its long temporal course. Resident kinaesthesis may show slight attributive changes during its brief temporal course; it never shows processual changes.[24]

B. Some Conditions of Resident and Projected Kinaesthetic Imagery

In the foregoing experiment, we obtained resident kinaesthetic imagery when the stimuli represented ordinary situations, such as stooping to pick up a pencil. But these stimuli always referred to the self: "Feel: yourself stooping to pick up a pencil." Further, we obtained projected kinaesthetic imagery when the stimuli represented unusual situations and movements not likely to have been made by the *O*'s, such as walking a tight rope. But these stimuli referred always to someone else: "Feel: an acrobat walking a tight rope."

[24] Cutaneous projections, which are usually referred to association, as when we say a thing looks cold or hard, may very well be, in the light of these results, projections at the level of perception. But we know hardly anything of cutaneous imagery.

We asked ourselves, then, which is the stronger influence upon resident and projected kinaesthesis, the influence of the usual and unusual, or the influence of the self and another? The natural thing to do was to reverse the situations, so that the usual should refer to another person, the unusual to oneself. We made out new paired commands which fulfilled this requirement.

We found that one of three things happened. (1) As a rule, the *O*'s reported resident kinaesthesis with the stimuli referring to the self, and projected kinaesthesis with the stimuli referring to the other person, in spite of the usualness or unusualness of the situation. (2) Sometimes the report was mixed, resident kinaesthetic imagery occurring for part and projected for part of the same situation. This mixture occurred with stimuli referring to the self making some strange movement. The thought of the movement would begin in resident kinaesthetic imagery, but the imagery would quite suddenly project itself without changing the meaning in any way except to make the self-reference uncertain. The *O* would say: "I think that was myself in the projected imagery, but I am not at all sure; it was a detached self." Every *O* who experienced this projected kinaesthesis in the midst of resident said: "I wonder if the projection happened there because I have never performed such a movement." Thus H, under the instruction "Feel: yourself making a hundred yard leap on a pair of skis," experienced the beginning of the leap in resident kinaesthesis, the movement through the air in projected kinaesthesis, and the landing in resident imagery. He said: "I have never leaped on a pair of skis, but I have made leaps, and that may be the reason that I had resident for the beginning and end of the leap." (3) Sometimes pure projected kinaesthesis resulted when the stimulus referred to the self performing a very strange feat.

We now had the reversal from resident to projected kinaesthesis for certain situations referring to the self in a strange situation; but we had not the corresponding reversal from projected to resident for usual situations referring to someone else. We thought that the failure to obtain the second reversal might be due to the fact that our stimuli for these experiments did not equal in familiarity the strangeness of the stimuli for the first reversal; *i. e.*, the *O*'s were *shocked* into projection by the strangeness of the one, and they must be *shocked* into resident imagery by the familiarity of the other. We therefore changed our situations, making them refer to someone else figuring in situations in which we had seen our *O*'s figure only a few days before. Immediately, and to the immense surprise of the *O*'s themselves, who had come to expect projection for all situations referring to other persons, resident kinaesthesis resulted.

We found, then, that the *O*'s could be shocked into projection in spite of the self-determination, and could be shocked into resident kinaesthesis in spite of the other-determination. The conditions thus cut across each other; ordinary usualness-unusualness is less strong a determinant than selfness-otherness, but a salient familiarity-strangeness, coming to the *O* with a shock of surprise, may reverse the normal conditioning of the two modes of imagery. It is plain that we are here upon the threshold of a highly complex problem, whose resolution will require methods more refined than those which we had at our disposal in the present study.

Conclusion

(1) Kinaesthetic images of memory may be distinguished from kinaesthetic sensations by uniformity, simplicity, and lack of 'body.' Kinaesthetic memory-images are uniform: always tiny bits of pressure, absolutely lacking in brightness. They are simple: they approximate single processes, and take on few or no perceptive characters. They lack 'body:' they are low in all the intensive attributes save vividness. Kinaesthetic sensations in a perception of movement are varied, complex, and have 'body;' they are now of one quality, now of another; they are sometimes high in all intensive attributes, sometimes high in only one, but always have more 'body' than the image; they constitute a sensory complex rich in all the perceptive characters.

(2) Kinaesthetic imagery may be classified under two main headings, resident and projected. The resident kinaesthetic images are referred ordinarily to oneself; the projected kinaesthetic images are referred ordinarily to someone else or something else. Resident kinaesthetic images may approximate simple processes, co-ordinate with sensation; projected kinaesthetic images constitute imaginal complexes, co-ordinate with perception. Resident kinaesthetic images show a psychological picture very different from the picture of kinaesthetic sensations in sensory complexes; projected kinaesthetic images in an imaginal complex show a psychological picture very like the picture of kinaesthetic sensations in a sensory complex. Resident kinaesthetic images are changing, fleeting, and involve an attitude which is passive, receptive, realizing; projected kinaesthetic images are invariable and persistent, and involve an attitude which is active, exploratory, detached, scrutinising.

(3) The difference between resident and projected kinaesthesis does not reflect merely the functional distinction of self and other; it is correlated with a specific difference of attitude on the part of the observer.

AFFECTIVE TENDENCY AS CONDITIONED BY COLOR AND FORM[1]

By MATSUSABURO YOKOYAMA

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INTRODUCTION

This investigation studies the simultaneous effect of two aspects of a simple sensory material in conditioning affective tendency, and the nature of the affective resultant. The

[1] From the Psychological Laboratory of Clark University. The writer wishes to acknowledge his indebtedness to Dr. L. R. Geissler for suggestions in the initiation of this research.

The present article has been condensed for purposes of publication by the omission of numerous tables that present special details or represent intermediate phases of the quantitative argument and by the abbreviation or elimination of much of the discussion. A complete bound manuscript, which gives the original data, the full numerical account and a complete discussion is available under this title in the Clark University Library and can be borrowed under the usual courtesies of library exchange.

problem in its broader phase—in its bearing upon the question of summation of affections—is not new. Wundt,[2] in his analysis of affective fusion, declares that the characteristic of feeling lies in the fact that all feelings present in consciousness at a given moment tend to fuse into a unitary manifold, a *Totalgefühl,* which, nevertheless, is not a mere sum of its components, but has a unique property of its own. Külpe,[3] MacDougall[4] and Titchener,[5] on the other hand, hold that the affection of any given moment is the algebraical sum of the affections attaching to all the various sensory processes that constitute the mind at that moment.

Unfortunately, however, there seems, with a single exception,[6] to have been no systematic experimentation in support of either of these views. The question occurs, it is true, in various studies of color-harmony and of mixed feelings;[7] but these are too few in number and of too fragmentary a nature to warrant general psychological conclusions. The problem, as it stands to-day, like other problems in affective psychology, is still in controversy, pending solution by experiment.

Procedure

The present work was conducted in the psychological laboratory of Clark University during the academic year 1919-1920.

Observers.—The observers in the experiment were B, Dr. E. G. Boring, who worked with knowledge of the problem; D, Dr. L. D. Boring; F, Dr. S. W. Fernberger; M, Miss M. Bates; P, Mr. C. C. Pratt. All but M were highly trained observers and had had experience in observation under the conditions of the experiment. M soon acquired introspective facility.

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[2] W. Wundt, *Physiologische Psychologie,* 6 Aufl., 1910, II, p. 351 ff.

[3] O. Külpe, *Outlines of Psychology,* trans., 3 ed., 1909, p. 264.

[4] W. MacDougall, *Physiological Psychology,* 1905, p. 80; *Body and Mind,* 3 ed., 1915, p. 313.

[5] E. B. Titchener, *Text-book of Psychology,* 1910, p. 258.

[6] L. R. Geissler, The Affective Tone of Color-Combinations, *Titchener Commemorative Volume,* 1917, 150-174. Geissler found that the pleasantness of color-pairs increases directly with the pleasantness of the colors taken individually.

[7] Jonas Cohn: Experimentelle Untersuchungen über die Gefühlsbetonung der Farben, Helligkeiten und ihrer Combinationen, *Philos. Stud.* 10, 1894, 562-603. C. H. Johnston: The Combination of Feelings, *Harvard Psychol. Stud.,* 2, 1906, 159-191. C. E. Kellogg: Alternation and Interference of Feelings, *Psychol. Mon.,* No. 79, 1905, 95 pp. A. Wohgemuth: Pleasure-Unpleasure, *Brit. J. Psychol. Mon. Supp.,* No. 6, 1919, 252 pp.

Stimuli.—The stimuli, except in Group II, were colored forms cut from the Milton-Bradley pigment papers and pasted on squares of neutral-gray cardboard, 14.5 x 17.5 cm. The list of stimuli and their designations follows:

Group I.
- Rs: red square, 5 x 5 cm.
- Os: orange square, 5 x 5 cm.
- Ys: yellow square, 5 x 5 cm.
- Gs: green square, 5 x 5 cm.
- Cs: cyan (bluegreen) square, 5 x 5 cm.
- Bs: blue square, 5 x 5 cm.
- Ps: purple (redviolet) square, 5 x 5 cm.

Group II. Each of the following forms is drawn in black ink on a neutral-gray cardboard, 14.5 x 17.5 cm. The thickness of the line is about 0.5 mm.
- Na: equilateral triangle, 7 cm. to a side, resting on its base.
- Nb: circle, radius 2.8 cm.
- Nc: annular sector, radius of larger arc, 7.3 cm.; of smaller arc, 2.5 cm.; placed convex upward; the two sides subtend an angle of 60 degrees.
- Nd: regular pentagon, 3.8 cm. to a side, resting on one of its angles.
- Ne: regular hexagon, 3.2 cm. to a side, resting on one of its angles.
- Nf: rectangle, 6 x 4.15 cm., resting on its shorter side.
- Ng: ellipse, major axis 3.5 cm.; minor axis 2.35 cm.; major axis horizontal.

Group III. 49 colored forms, *i. e.*, every color of Group I, combined with every form of Group II. Capitals designate the color (cf. Group II). Thus,

Ra, red triangle	Yd, yellow pentagon
Rb, red circle	Cf, cyan rectangle
Oc, orange sector	Pf, purple rectangle

The brightness of the colors and the gray cardboard (N) was determined by flicker photometry under the artificial daylight of a frosted 75-watt type C-2 Mazda lamp, 15 cm. distant. The average determinations for B and the writer, reading in both directions, and expressed in per cent of baryta white mixed with velvet black paper, are:

Colored paper	R	O	Y	G	C	B	P	N
White	11.7	32.3	91.2	46.5	39.5	12.9	19.5	38.1

Method and apparatus.—The method of paired comparisons was used throughout the entire course of experimentation.

The inapplicability of the method of choice for investigating the affective value of color has been shown by Cohn.[8] The value of the method of single exposures (*Reizmethode* after M. Brahn) has been questioned by Nakashima.[9] While the serial method (method of isolated exposures) has been highly recommended by Major,[10] it is

[8] Cohn, *op. cit.*, 564.
[9] T. Nakashima, *Amer. J. Psychol.*, 20, 1909, 180.
[10] D. R. Major, *Amer. J. Psychol.*, 7, 1895, 59.

not practicable in our research because of the non-serial nature of our stimuli. The method of paired comparisons was chosen, in spite of the objections of Gordon,[11] and Bullough[12] since it is the method which has been applied by Titchener,[13] Hayes,[14] Cohn,[15] Geissler,[16] and others with some degree of success in the investigation of affective problems.

Recently Barrett,[17] having tested experimentally the relative value of the order of merit method and the method of paired comparisons, came to the conclusion that the former is "vastly to be preferred to" the latter "from the standpoint of their relative demand upon the time and energy both of the experimenter and of the subjects." This conclusion, to be sure, is legitimate as far as it goes, but the use of the order of merit method is less desirable where scientific thoroughness is required. We tried this method for testing the preference of colors and forms on over 200 students of Wellesley and Clark Colleges, and found it quite unsatisfactory because of the observers' inability to comprehend the large number of stimuli, which inevitably led to various memorial confusions, as well as to neglect of areas beyond the visual range, and because of the tendency to make mediate judgments based upon reflection or upon previously established choices, *i. e.*, the tendency to be "logical." In addition to these defects, there were spatial errors, contrast effects, extraneous associations, *etc.*

A neutral gray cardboard screen, 120 x 57 cm. on a wooden framework was erected on a table 120 x 60 cm., 76 cm. high. In the center of the cardboard were two square openings, each 10.5 x 10.5 cm., placed side by side at a distance of 9.5 cm. The table on the side towards O was covered with neutral gray cloth which hung to the floor. On E's side of the screen an oblong board, 43 x 16 cm., was hinged to the wooden frame, 19 cm. above the table, in such a manner that it could be let down towards E and two stimulus cards arranged on it side by side with each card held in place by a triangular piece of tin into which one corner slipped. When this board was snapped up by a rubber band into the upright position the stimuli came directly behind the square openings. Hinged at the top of the screen and falling toward O was a neutral gray shutter, 45 x 27 cm., which completely covered the square openings. A string was attached to the shutter from behind so that it could be lifted by E, disclosing the stimulus without letting shadow fall upon it. A vernier chronoscope[18] was used for taking reaction times. It was

[11] K. Gordon, *Psychol. Rev.*, 19, 1912. 354.
[12] L. E. Bullough, *Brit. J. Psychol.*, 2, 1908, 411ff.
[13] Titchener, *Philos. Stud.*, 20, 1902, 382ff.
[14] S. P. Hayes, *Amer. J. Psychol.*, 17, 1906, 358-393.
[15] Cohn, *op. cit.*
[16] Geissler, *op. cit.*
[17] M. Barrett, *Psychol. Rev.*, 21, 1914, 278-294.
[18] *Cf.* E. C. Sanford, The Vernier Chronoscope, *Amer. J. Psychol.*, 9, 1897-1898, 191-197.

connected with the exposure-apparatus in such a way that one of the pendulums was automatically released by an electro-magnet when the shutter was raised. The other pendulum was similarly released when the reaction key was pressed by O.

O sat at a distance of 1.5 m. from the screen. The experiment took place in a dark-room. Light was furnished by two 75-watt frosted type C-2 Mazda daylight lamps, about 75 cm. behind O and a little to the right and left.

The actual procedure was as follows. At the beginning of each experiment, the ready signal was given by E who sat in the rear of the screen and manipulated the apparatus. About two seconds later, E raised the shutter and presented a pair of stimuli for three seconds. O, seated comfortably in his chair, faced the screen and announced his judgment by reacting upon a key with his right hand and stating subsequently whether his judgment has been "left" or "right." Immediately after recording O's judgment and reaction time, E shifted the stimuli and set the chronoscope for the next exposure. An interval from twenty to thirty seconds was necessary.

The experiment was continued in this fashion for the first thirty-five minutes of each session, after which a short intermission was given. The remaining time was chiefly devoted to taking introspections. B, D and F wrote their reports; M and P dictated them. It was possible to obtain about fifty comparisons and one or more introspective reports in an hour.

Instructions.—The instructions finally adopted were typewritten and read by O at the beginning of each session.

Instruction I. (For the comparison of colors.)

"In each experiment after the ready signal two colors will be exposed for a short time in the square openings of the screen. You are to give yourself up entirely to color-quality. You are to assume the attitude of passively living the color. You are not to be critical toward the stimulus or to concern yourself with extrinsic references, but to take the color simply in its own right. *Immediately* after the colors are perceived, indicate the one which you prefer as the more pleasant by pressing the key and by saying the word 'left' or the word 'right,' according as the left or the right color is preferred.

"Whenever you think you have failed to live up to this instruction, indicate that fact to the experimenter."

Instruction II. (For the comparison of forms.)

Same as Instruction I with "form" substituted for "color," and "form-aspect" substituted for "color-quality."

Instruction III. (For the comparison of color-forms.)

Same as Instruction I with "color-form" substituted for "color" and "color-quality."

When introspection was desired, the following instruction was given orally:

"In the next experiment, describe in detail your affective experience, with particular reference to the nature and mechanism of your judgment."

The observers were further instructed to indicate unambiguously cases of doubt, indecision, or of equality. D, F, M, and P were frequently unable to report upon the more pleasant stimulus, since each member of the pair was actually unpleasant; they were then allowed to base their preference upon the less unpleasant stimulus.

Order of experiment.—The experiment was divided into five parts. Parts I and V were planned to test the permanence of O's judgments upon colors and forms throughout the experimental period. The main experiment consisted of Parts II, III, and IV. Part II dealt with colors; Part III, with forms; and Part IV, with color-forms. The order for all O's but M is outlined below. M observed in the reversed order and did not participate in Parts I and V.

Part I.

Series S. The comparison of colors.

Instruction I. Stimuli, Group I (*q. v.*)
21 comparisons of colors in one spatial order, *i. e.*, each of the 7 colors compared with each of the 6 other colors, $7 \times 6/2 = 21$; and the repetiton of the same in reversed spatial order, 42 comparisons in all.

Series N. The comparison of forms.

Instruction II. Stimuli, Group II (*q. v.*)

21 comparisons of forms in one spatial order, *i. e.*, each of the 7 forms compared with each of the 6 other forms, $7 \times 6/2 = 21$; and the repetiton of the same in reversed spatial order, 42 comparisons in all.

Part II. The comparison of colors. Identical with Part I, Series S, except as to stimuli.
Instruction I. Stimuli, Group III (*q. v.*)

Series	Stimuli							
a	Ra	Oa	Ya	Ga	Ca	Ba	Pa	21 comparisons in each of 2 spatial orders for each series; 2 x 21 = 42 comparisons in each series, 7 x 42 = 294 comparisons in all
b	Rb	Ob	Yb	Gb	Cb	Bb	Pb	
c	Rc	Oc	Yc	Gc	Cc	Bc	Pc	
d	Rd	Od	Yd	Gd	Cd	Bd	Pd	
e	Re	Oe	Ye	Ge	Ce	Be	Pe	
f	Rf	Of	Yf	Gf	Cf	Bf	Pf	
g	Rg	Og	Yg	Gg	Cg	Bg	Pg	

Part III. The comparison of forms. Identical with Part I, Series N, except as to stimuli.

Instruction II. Stimuli, Group III.

Series	Stimuli							
R	Ra	Rb	Rc	Rd	Re	Rf	Rg	21 comparisons in each of 2 spatial orders for each series; 2 x 21 = 42 comparisons in each series. 7 x 42 = 294 comparisons in all.
O	Oa	Ob	Oc	Od	Oe	Of	Og	
Y	Ya	Yb	Yc	Yd	Ye	Yf	Yg	
G	Ga	Gb	Gc	Gd	Ge	Gf	Gg	
C	Ca	Cb	Cc	Cd	Ce	Cf	Cg	
B	Ba	Bb	Bc	Bd	Be	Bf	Bg	
P	Pa	Pb	Pc	Pd	Pe	Pf	Pg	

Part IV. The comparison of color-forms.

Instruction III. Stimuli, Group III. Series 1 to 24 inclusive.

1176 comparisons of color forms in one spatial order only, *i. e.*, each of the 49 color-forms compared with each of the other color-forms, $49 \times 48/2 = 1176$. Series 1 and 2 consisted of 42 comparisons each; series 3, of 63; and each of the rest, of 49.

Part V.

Series S′ = Repetition of Part I, Series S.
Series N′ = Repetition of Part I, Series N.

The stimuli were presented in haphazard order, with the precaution that no stimulus should appear twice in succession. The same stimuli, differently arranged, were used in Parts II, III, and IV. Thus, the isolation of color (Part II) and of form (Part III) was accomplished solely by the direction of attention. It would, of course, be ideal if we were able to present formless colors and colorless forms for the experiments on colors and forms. The use of the same stimuli in all parts of the main experiment did not, however, introduce any measurable disadvantage in the investigation, for the observers acquired skill in isolating under attention the color or form from the color-form and in attending to the one or the other separately.

Affective Judgment under the Method of Paired Comparisons

At the outset of this investigation, we had no definite knowledge regarding the practicability of the method of paired comparisons in dealing with our particular problem, nor did we have any exact conception of the nature of affections induced under this method. The choice of the method was quite arbitrary; it was, however, the only purely psychological method available, the only method that experimentalists might agree upon as furnishing the conditions or definition of the

generally conceded affective process. We found, as have our predecessors, that the results obtained with this method are of a positive character as far as their quantitative aspect is concerned, and that pleasantness and unpleasantness are not only reportable, but that judgments upon them may be nearly as immediate as judgments upon sensory impressions. Nevertheless the observers worked under very different attitudes and, so far as their introspective reports are admissible as evidence, we found their judgments based upon different sorts of psychological processes. This divergence in type of judgment led to less inconsistency in the nature of the data than might be expected, although the introduction of a critical introspective attitude undoubtedly accounts for the instability of some of the results. A characterization of these differences is in place here, since it reflects the limitations of the method; a critical study of the introspections which show these differences must, however, wait for a later article.

In a preliminary survey of the introspective data of our four practiced subjects, it appears that the affective judgments may be of two distinct types which depend upon two different attitudes,—a sensorial attitude and an objective attitude. The sensorial attitude presumably grew out of an instruction for introspection. Either the observers understood the instruction that they were sometimes to report introspectively upon the judging process to mean that they were to judge processes, or else the general introspective habits of the laboratory operated toward a similar self-instruction. The fact seems to be that the observers who sought to base their judgments upon introspectable material tended actually to base them upon sensory process, and that this introspective attitude is actually a sensorial attitude. Observer B's judgments were of this type. He approached the experiment with a firm conviction that if the affection is an existential mental process, it must be directly observable by introspection and his attitude throughout the experiment was characteristically introspective. He found, however, that pleasantness and unpleasantness were for him nonexistential in this psychological sense, that they were always 'meanings' or conscious attitudes based definitely under these particular conditions upon some particular sensory pattern. In order to make an affective judgment, however, it was always necessary for him to have some essential sensory cue, and his reaction-times, which were comparatively long, reflect this intervention of a sensory mediator between the perception of the stimulus and the arousal of the judgment. D also worked in the sensorial atti-

tude, characterizing affections as meanings carried by organic sensations. P reported them as observable psychological elements, but concomitant with organic and kinaesthetic processes. F, on the other hand, approximated the objective attitude, under which the stimulus is focal and introspected process is of secondary account. This attitude is in the spirit of the major instructions and F followed these instructions uncritically and was very receptive. His judgments after a little practice became mechanized and quick, as might have been expected, since there appeared to be no process-intermediary to retard the course. Although he became, during the course of the experiment, convinced that judgments of preference might be made without the presence of either of the affective qualities, he believed, nevertheless, that pleasantness and unpleasantness do exist as mental elements.

These results are especially suggestive in so far as they throw light upon the question of the psychological status of affection and the manner in which the problem of meaning enters into the problem of feeling. It is nothing new for observers in the same experiment to disagree over the nature of affection,[19] and the applicability of the introspective method is seriously open to question. Nevertheless the problem needs to be faced in the light of protocols obtained from observers trained in the introspective method and with their wits keen to note the incursions of meaning and *Kundgabe* upon the field of existential process. This issue remains; it is not immediately involved in the present problem, and it seems preferable to reserve it for separate treatment later.

It has seemed advisable tentatively to adopt the term "affective tendency" in this study because the entities involved (number of preferences) are statistical data and not immediately given and because the conceptual bases of the affective judgment must necessarily be as little directly observable as are the associative and determining tendencies. The difficulties and divergences of our observers emphasize again the elusiveness of the immediately observable affective datum, and the experiment as a whole brings to the fore what seems to be the available material at the bottom of the experimentalist's belief in affection, *viz.*, the statistical relative frequencies of preferences. And the term tendency, so it seems, is used by psychologists to represent those mental entities that appear thus in statistical settings.

[19] Nakashima, Contributions to the Study of the Affective Processes, *Amer. J. Psychol.*, 20, 1909, 180ff.

TABLE I

PERMANENCY OF AFFECTIVE JUDGMENT

Percents of agreement between early series (Part I; S, N) and late series (Part V; S^1, N^1). S and S^1 are for colored squares; N and N^1 for "neutral" forms. Obs.: B, D, F, P. Colors O and P omitted in |" B (revised.)"

	B	D	F	P	B (Revised)
S & S^1	64.3	90.5	100.0	92.9	90 0
N & N^1	90.5	95.2	100.0	88.1	90.5

Degree of Permanency of Affective Judgment (Results of Parts I and V; Instructions I and II.)

Table I indicates in terms of percentages of agreement,[20] the degree of permanence of O's affective judgments on colors and on forms just before (Part I) and after (Part V) the main experiment. Inspection will show clearly that, except in case of B, the influence of time,—as might be expected from the result of Bradford,[21]—is too small to change the preferential order of colors and forms. The low degree of consistency of B's judgments on colors is due apparently to a change in his preference for purple and orange during the progress of experiment. The omission of orange and purple from calculation of B's results gives a much higher percentage of agreement for colors without causing any change for forms (Table I, last column).

Of this change B remarked: "Purple became more pleasant than it used to be. I liked it better than red." Since the objective conditons of experiment have been kept fairly constant throughout and since no other salient cause is discoverable, we are justified in attributing B's change to the relative inconstancy of his attitude during the long interval of time. On the other hand, having shown that the degree of consistency of our observers' affective judgments in general is high and that therefore the preferential order for colors and for forms is not the result of transient conditions, we may

[20] See W. S. Foster and K. Roese, Tridimensional Theory of Feeling from the Standpoint of Typical Experiences, *Amer. J. Psychol.*, 27, 1916, 161, for the calculation of these. Our "per cent of agreement" is obtained by multiplying their 'degree of similarity' by 100.

[21] E. J. C. Bradford, A Note on the Relation and Aesthetic Value of the Perceptive Types in Color Appreciation, *ibid.*, 24, 1913, 545-554.

safely conclude that the affective tendency of colors and forms can be determined psychophysically in experimental series extending over as long a period as that of our main experiment (Parts II, III, IV).

TABLE II

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. B.

Upper right half of the table shows percents of agreement for colors between every pair of forms; attention on color (Instruction I.) Lower left half of the table shows percents of agreement for forms between every pair of colors; attention on form (Instruction II.)

Av. for Color = 80.3; M.V. = 5.0

COLOR

		b	c	d	e	f	g	Form
		88.1	81.0	78.6	69.0	88.1	78.6	a
O	90.5		88.1	85.7	71.4	88.1	78.6	b
Y	90.5	90.5		81.0	69.0	81.0	73.8	c
G	88.1	90.5	92.9		71.4	90.5	81.0	d
C	88.1	90.5	92.9	100.0		76.2	88.1	e
B	81.0	85.7	90.5	95.2	95.2		85.7	f
P	88.1	95.2	88.1	90.5	90.5	85.7		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 90.5; M. V. = 2.7

TABLE III

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. D

See Legend of Table II

Av. for color = 90.7; M. V. = 3.2

COLOR

		b	c	d	e	f	g	Form
		95.2	95.2	92.9	85.7	95.2	85.7	a
O	85.7		95.2	95.2	88.1	90.5	88.1	b
Y	95.2	83.3		92.9	90.5	95.2	90.5	c
G	90.5	81.0	85.7		83.3	90.5	88.1	d
C	95.2	85.7	95.2	85.7		85.7	92.9	e
B	90.5	81.0	85.7	90.5	85.7		88.1	f
P	90.5	90.5	85.7	90.5	85.7	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 88.1; M. V. = 3.6

TABLE IV

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. F.

See Legend of Table II

Av. for color = 94.8; M. V. = 2.2

COLOR

		b	c	d	e	f	g	Form
		95.2	90.5	95.2	90.5	100.0	100.0	a
O	90.5		95.2	95.2	95.2	95.2	95.2	b
Y	95.2	95.2		95.2	100.0	90.5	90.5	c
G	90.5	90.5	95.2		95.2	95.2	95.2	d
C	95.2	85.7	90.5	85.7		90.5	90.5	e
B	95.2	95.2	100.0	95.2	90.5		100.0	f
P	95.2	95.2	100.0	95.2	90.5	100.0		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 93.7; M. V. = 3.3

TABLE V

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. M.

See Legend of Table II

Av. for color = 82.0; M. V. = 5.5

COLOR

		b	c	d	e	f	g	Form
		76.2	71.4	81.0	76.2	76.2	81.0	a
O	90.5		85.7	95.2	81.0	88.1	90.5	b
Y	71.5	76.2		85.7	76.2	76.2	76.2	c
G	76.2	76.2	66.7		85.7	85.7	90.5	d
C	66.7	76.2	90.5	76.2		90.5	76.2	e
B	76.2	85.7	71.4	85.7	76.2		81.0	f
P	81.0	88.1	76.2	81.0	76.2	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 78.8; M. V. = 6.0

TABLE VI

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. P.

See Legend of Table II

Av. for color = 91.8; M. V. = 3.4

COLOR

		b	c	d	e	f	g	Form
		97.6	81.0	90.5	92.9	97.6	92.9	a
O	85.7		85.7	92.9	95.2	100.0	92.9	b
Y	95.2	90.5		92.9	90.5	85.7	88.1	c
G	90.5	92.9	88.1		92.9	92.9	85.7	d
C	95.2	90.5	90.5	95.2		95.2	92.9	e
B	90.5	95.2	95.2	92.9	95.2		92.9	f
P	90.5	90.5	85.7	95.2	95.2	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 91.9; M. V. = 2.7

TABLE VII

MUTUAL INDEPENDENCE OF COLOR AND FORM: REVISED RESULT OF OBS. B.

See Legend of Table II. Colors O and P omitted because of inconstancy.

Av. for color = 86.7; M. V. = 5.6

COLOR

		b	c	d	e	f	g	Form
		95.0	85.0	90.0	80.0	95.0	95.0	a
Y	90.5		85.0	90.0	85.0	90.0	100.0	b
G	88.1	92.9		85.0	70.0	85.0	85.0	c
C	88.1	92.9	100.0		75.0	90.0	90.0	d
B	81.0	90.5	95.2	95.2		75.0	85.0	e
							90.0	f
Color	R	Y	G	C				

FORM

Av. for form = 91.4; M. V. = 3.8

Mutual Independence of Color and Form in Conditioning Affective Tendency of Color and Form respectively under Attentive Isolation (Results of Parts II and III, Instructions I and II.)

The results of Parts II and III are summarized in Tables II-VII. Each number in the upper right half of these tables is a percentage of agreement between the preferential order of colors of one form and the preferential order of the same colors with another form. The numbers in the lower left half are percentages of agreement of the preferential order of forms for pairs of colors. For example, in Table II, the figure 88.1 below 'f' and opposite 'a' is the percentage of agreement between the order of colors of series f (colors of form f) and the order of colors of series d (colors of form d); 90.5 above "R" and opposite "O" in the same table is the agreement between the preferential order of forms colored R and the order of forms colored O.

The percentages of agreement between the various series for both color and form are very high, ranging from 61.9 to 100.0 in case of the former, and from 66.7 to 100.0 in the latter. The averages of all the observers are 87.9 for color and 88.1 for form with the M. V's 3.9 and 3.7 respectively. These agreements are high enough to warrant a conclusion that when color-forms are presented for affective comparison of colors only, the forms have practically no influence upon the preferential order of these colors, provided the observer's attitude remains constant throughout the task, and that color similarly has practically no effect upon form. Color and form, then, may be said to be each independent of the other in conditioning affective tendency where each is isolated from the other by attentive abstraction.

This conclusion follows even in the face of relatively low degree of consistency of M's affective judgments on color and form and of B's on color. In B's case, as we have noted, purple and orange proved always the disturbing factors in his otherwise regular preferences. The M. V's of the scores of these colors were each greater than one-fourth of their averages. The inconsistency is plainly conditioned upon the nature of these two colors and not in any way upon form. (See Table VII, 'revised result' for B.) The case of M is of more significance, as these experiments were performed after she had completed 1176 comparisons of color-forms, and she was therefore expected to have a fixed set of preferential orders. However, there is no reason to assume that her failure to attain a higher degree of consistency is to be attributed to the mutual influence of color and form, exhibited

by no other observer; rather it is reasonable to believe that, being untrained in psychological experimentation, she misunderstood the instructions, attempting to secure speed rather than accuracy. Moreover, it may be that she worked with various criteria of pleasantness, without sufficient discrimination, and thus gave inconstant results. These indications are borne out by her extraordinarily short reaction times and her frequent premature judgments, as well as by her own introspections, in which not infrequently are found such sentences as: "I chose the right in spite of myself," "the left was so impressive that I judged it as more pleasant, though I knew I liked the right better." It is also pertinent to observe that she had no decided preference among the forms as she did among the colors, and that the degree of consistency for forms is therefore even lower than for colors.

TABLE VIII

AFFECTIVE VALUES OF COLOR-FORMS: OBS. B.

Number of preferences under method of paired comparisons for every colored form with attention on color-form (Instruction III). Rows show comparisons of forms for every color; columns show comparisons of colors for every form.

	a	b	c	d	e	f	g	Av.	M.V.
R	32.5	48.0	29.5	35.5	38.0	37.5	42.0	37.6	4.37
O	10.0	24.5	1.5	11.5	25.5	10.5	19.5	14.7	7.24
Y	17.0	41.0	17.0	25.5	27.0	15.5	29.5	24.6	6.98
G	24.5	36.0	25.0	28.0	34.5	28.5	36.5	30.4	4.50
C	2.5	25.0	3.5	7.0	11.5	3.0	10.0	8.9	5.68
B	14.5	39.0	18.5	24.5	30.0	17.5	34.0	25.4	7.64
P	20.5	38.0	13.0	25.0	31.0	21.0	35.5	26.3	7.33
Av.	17.3	35.8	15.4	22.4	28.2	19.1	29.6		6.25
M. V.	7.26	6.45	8.08	7.53	5.90	8.51	8.49	7.46	

TABLE IX

AFFECTIVE VALUES OF COLOR-FORMS: OBS. D.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	35.0	35.0	41.0	41.0	38.0	33.0	37.5	37.2	2.47
O	8.0	1.0	18.0	16.0	11.5	0.0	2.0	8.1	6.08
Y	15.5	7.0	30.0	28.0	22.0	4.0	7.0	16.2	8.96
G	12.0	8.0	28.0	25.0	18.0	6.5	11.0	15.5	7.00
C	25.0	21.0	34.0	33.5	27.0	16.0	23.0	25.6	5.02
B	45.0	42.0	48.0	46.0	45.0	42.0	43.0	44.5	1.79
P	25.0	15.5	32.0	31.0	20.0	7.0	16.0	20.9	7.20
Av.	23.6	18.5	33.0	31.5	25.9	15.5	19.9		5.50
M.V.	10.12	12.14	6.86	7.43	9.20	12.71	12.49	10.14	

TABLE X

AFFECTIVE VALUES OF COLOR-FORMS: OBS. F.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	38	37	47	35	31	19	43	35.7	6.33
O	32	27	44	27	22	14	42	30.0	8.29
Y	21	19	37	14	11	7	31	19.7	8.24
G	6	2	13	4	1	0	7	4.7	3.39
C	16	14	27	12	8	7	25	15.7	6.10
B	41	40	48	37	33	23	46	38.3	6.24
P	26	24	38	21	15	10	33	23.9	7.31
Av.	25.7	23.4	36.1	21.6	17.3	11.4	32.4		6.56
M.V.	9.76	9.94	9.37	11.37	9.76	6.20	9.80	9.46	

TABLE XI

AFFECTIVE VALUES OF COLOR-FORMS: OBS. M.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	29.0	45.0	36.0	41.0	41.0	27.0	43.0	37.4	5.80
O	13.0	24.0	19.0	18.0	27.5	17.5	24.5	20.5	4.14
Y	10.0	35.0	28.0	24.0	26.0	17.0	32.0	24.6	6.49
G	10.0	12.0	6.5	3.5	11.0	5.0	20.0	9.7	4.04
C	14.5	25.0	14.5	13.0	11.5	7.5	15.0	14.4	3.22
B	34.0	47.0	44.0	40.0	42.0	32.0	44.0	40.4	4.37
P	12.5	30.0	26.0	24.0	22.5	10.5	21.0	20.9	5.39
Av.	17.6	31.1	24.9	23.4	25.9	16.6	28.5		4.78
M.V.	7.96	9.59	9.88	10.16	9.37	7.69	9.57	9.17	

TABLE XII

AFFECTIVE VALUES OF COLOR-FORMS: OBS. P.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	27.5	34.0	35.0	35.0	45.0	16.5	47.0	34.3	7.10
O	24.0	28.0	29.0	36.0	39.0	17.0	44.0	31.0	7.43
Y	21.0	23.0	23.0	32.0	36.0	17.0	40.0	27.4	7.35
G	6.5	5.0	6.5	8.5	10.0	2.5	13.5	7.5	2.79
C	7.5	8.5	8.5	8.5	11.0	1.0	17.5	8.9	3.04
B	33.0	38.0	37.0	40.0	46.0	27.0	47.0	38.3	5.18
P	19.0	15.0	16.5	23.0	30.0	10.5	30.0	20.6	6.08
Av.	19.8	21.6	22.2	26.7	31.0	13.1	34.1		5.57
M.V.	7.53	10.41	10.04	10.89	12.00	7.20	11.84	9.99	

TABLE XIII

AFFECTIVE VALUES OF COLOR-FORMS: REVISED RESULT OF OBS. B

See legend of Table VIII. Colors O and P omitted because of inconstancy.

	a	b	c	d	e	f	g	Av.	M.V.
R	22.5	34.0	19.0	23.5	26.0	24.5	29.0	25.5	3.21
Y	11.5	28.5	9.0	16.5	17.0	10.5	19.5	16.1	4.92
G	15.5	25.5	17.0	19.0	25.0	20.5	25.0	21.1	3.51
C	1.5	16.5	1.0	4.0	7.0	2.5	6.5	5.6	3.80
B	9.5	27.5	11.0	17.5	20.0	8.5	23.5	16.8	6.10
Av.	12.1	26.4	11.4	16.1	19.0	13.3	20.7		4.31
M.V.	5.52	4.32	5.48	4.84	5.60	7.36	6.16	5.61	

Concurrent Operation of Color and Form upon Affective Tendency (Parts II, III and IV).

Affective values of color-forms. (Part IV; Instruction III.)—Tables VIII-XIII inclusive give the result of Part IV, the experiment upon the forty-nine stimuli with attention upon "color-form." In each table the figures in the first seven rows and columns are the absolute frequencies of choice made upon these color-forms by each observer. Further, these tables are so arranged that each row contains the scores of seven color-forms, different from one another in form and identical in color, and thus show implicitly the preferential order of seven forms, all of the same color; while, conversely, each column exhibits the preferential order of seven colors, all in the same form. The averages and M.V's are respectively placed in the rows and columns so named. For example, let us take Table VIII (Obs. B). The figures 32.5, 48, 29.5, *etc.*, respectively under a, b, c, *etc.*, in the row R indicate the scores of the color-forms, Ra, Rb, Rc, *etc.*, establishing the preferential order of the forms, a, b, c, *etc.*, for the color red. Likewise, the figures, 48, 24.5, 41, *etc.*, respectively opposite R, O, Y, *etc.*, in the column b may be taken either as the number of choices of the color-forms, Rb, Ob, Yb, *etc.*, or as indicative of the preferential order of the colors, R, O, Y, *etc.*, in the form b, the circle.

Effect of instruction upon preference. (Comparison of Parts II and III with IV.)—In order to measure the influence of the direction of attention upon affective tendency, the preferential orders of colors with attention directed upon color only (Part II, Instruction I) and of forms with atten-

TABLE XIV

EFFECT OF DIRECTION OF ATTENTION

Correlation for colors between ranks with attention on color-quality (Instruction I) and ranks with attention on color-form (Instruction III). "Av." = av. correlation and av. P.E. "M. V." = M.V. of "Av." "Correl. Av." = correlation of av. of all forms for every obs. "B (revised)" = B's results with colors O and P omitted.

Obs.	B		D		F		M		P		Av. for All obs.		B (revised)	
Form	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.
a	0.86	0.07	0.92	0.04	1.00	0.00	0.43	0.22	0.96	0.02	0.83	0.07	0.88	0.07
b	0.56	0.17	0.88	0.06	1.00	0.00	0.87	0.07	0.99	0.01	0.86	0.06	0.55	0.22
c	0.90	0.05	0.99	0.01	0.96	0.02	0.93	0.04	0.98	0.01	0.95	0.02	0.90	0.06
d	0.46	0.21	0.94	0.03	0.99	0.01	0.90	0.05	0.94	0.03	0.85	0.07	0.88	0.07
e	0.64	0.16	0.94	0.03	0.96	0.02	0.74	0.12	1.00	0.00	0.86	0.07	0.90	0.06
f	0.63	0.16	0.85	0.08	0.99	0.01	0.81	0.09	0.83	0.08	0.82	0.08	0.90	0.06
g	0.67	0.15	1.00	0.00	1.00	0.00	0.88	0.06	0.93	0.04	0.90	0.05	0.95	0.03
Av.	0.68	0.14	0.93	0.03	0.99	0.01	0.89	0.09	0.95	0.03	0.87	0.06	0.85	0.09
M. V.	0.12		0.04		0.01		0.12		0.04		0.03		0.09	
Correl. Av.	0.74	0.12	1.00	0.00	1.00	0.00	0.96	0.02	1.00	0.00	0.94	0.03	0.90	0.06

TABLE XV

EFFECT OF DIRECTION OF ATTENTION

Correlation for forms between ranks with attention on form-aspect (Instruction II) and ranks with attention on color-form (Instruction III). "Av." = av. correlation and av. P.E. "M. V." = M.V. of "Av." "Correl. Av." = correlation of av. of all colors for every obs. "B (revised)" = B's results with colors O and P omitted.

Obs.	B		D		F		M		P		Av. for All obs.		B (revised)	
Color:	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.
R	0.89	0.05	0.94	0.03	1.00	0.00	0.26	0.25	0.92	0.04	0.80	0.04	0.90	0.05
O	0.86	0.07	0.96	0.02	0.94	0.03	0.56	0.18	0.89	0.05	0.84	0.07	....	....
Y	0.88	0.06	0.93	0.04	0.99	0.01	0.39	0.23	0.96	0.02	0.83	0.07	0.96	0.02
G	0.89	0.05	0.96	0.02	0.89	0.05	0.21	0.26	0.88	0.06	0.77	0.09	0.92	0.04
C	0.86	0.07	0.96	0.02	1.00	0.00	0.19	0.26	0.96	0.02	0.79	0.07	0.96	0.02
B	0.82	0.09	0.98	0.01	0.99	0.01	0.62	0.17	0.99	0.01	0.88	0.06	0.75	0.12
P	0.96	0.02	0.96	0.02	0.99	0.01	0.77	0.11	0.80	0.10	0.90	0.05	....	....
Av.	0.88	0.05	0.95	0.02	0.97	0.02	0.43	0.21	0.92	0.03	0.83	0.07	0.90	0.03
M. V.	0.03		0.02		0.03		0.19		0.05		0.04		0.06	
Correl. Av.	1.00	0.00	1.00	0.00	1.00	0.00	0.46	0.21	0.96	0.02	0.89	0.05	1.00	0.00

tion directed upon form only (Part III, Instruction II) were compared by the method of rank-differences with the results for color and form respectively with attention upon 'color-form' (Part IV, Instruction III). The correlations are indicated in Tables XIV (color) and XV (form).[22] In table XIV, 0.90 under "ρ" and opposite "c," for instance, is the

coefficient of correlation between the preferential orders of colors of the form c obtained in Part II and in Part IV; the figure 0.05 adjacent to it is the probable error of this ρ. Similarly, in Table XV, the figure 0.89 under " " and opposite " R " is the coefficient of correlation between the preferential orders of forms of the color red obtained in Part II and in Part IV, *etc.*

Examination of these tables reveals the fact that the coefficients of correlation, whether they be between the preferential orders of clors or of forms, are high for the observers D, F, and P, never falling below 0.80 and never with the P.E. exceeding one tenth of ρ. Indeed, for these observers, the correlation is perfect or nearly so when computed for the average ranks of colors or of forms. (Table XIV, row 'Correl. Av.', and Table XV, row 'Correl. Av.'.) With B (color) and M (both color and form), the correlation is less significant than with the other observers.

It might be argued *a priori* that the poor result of M is due mainly to the fact that she had worked with the color-forms before she worked with the separate colors and forms, and that thus her judgments of the color-forms were relatively independent of the affective tendencies intrinsic to the colors and forms. Since Geissler, however, has already proved in his investigation of the influence of the affective tone of single colors on the affective tone of their combinations that there is no difference in the actual result whether the individual colors are presented before or after the color-pairs,[23] the writer is inclined to question the validity of any such claim. The more salient causes for the instability of her judgments seem to lie in the precarious nature of her attitude and her apparent lack of decided preference for any particular forms (see above). B's low correlation for the colors (0.77) results from the inconstancy of his judgments with the orange and purple stimuli. The recalculation of his data after eliminating the judgments on all the orange and purple stimuli raises the coefficient of correlation (Tables XIV and XV, last column) greatly between Part II and IV and between Part III and IV.

Taken all in all, there is a high degree of correspondence between the results of Parts II and III, and Part IV for all the observers, thus indicating that color and form operate as affective conditions independently of the direction of attention.

Degree of independence of color and form in conditioning affective tendency of color-form.—The failure to attain per-

[22] The formulae used were: $\rho = 1 - \frac{6 \Sigma D^2}{n (n^2 - 1)}$, and

$\text{P.E.}_\rho = 0.706 \frac{1-\rho^2}{n}$.

[23] Geissler, *op. cit.*

fect correlations in the foregoing analysis may be attributed either to fluctuations of the observers' attitude under a given *Aufgabe,* or to the mutual effect of color and form upon the preferential order for each when the two are combined and judged as color-forms. Accordingly, if for the sake of simplicity we ignore, for a moment, the first of these factors (although there is every reason to believe that it was an important cause in effecting the inconstant results) and consider the data as indicative of mutual effects only, then the coefficients of correlation may be looked upon as the indices of the degrees of independence of color and form, one from another, as they condition the affective tendencies of the color-forms; and, conversely, the differences of these coefficients from unity may be taken as the measure of the degree of their mutual effect. It may be readily seen in Tables XIV and XV that, except in the cases of B and M, the effect is not very marked (ave. effects of forms on colors $= 1.00 - 0.87 = 0.13$, of colors on forms $= 1.00 - 0.83 = 0.17$). The variations (M.V's) between the effects of different colors and forms are comparatively large; yet no definite relation can be found between the relative effects of these colors and forms, and the relative intensities of their own affective tendencies. It is doubtful whether these variations are at all the result of interaction of color and form. That they might easily be due to vacillations in the observer's attitude appears from the fact that they vary from observer to observer according to the order of the inconstancy of attitude. (See analysis of Parts I, II and III). At any rate we may conclude that as far as relative pleasantness is concerned, color and form are, in the main, mutually independent in conditioning affective tendency of color-form.

TABLE XVI

RELATIVE EFFECTIVENESS OF SEPARATE COLORS IN CONDITIONING AFFECTIVE TENDENCY OF COLOR-FORM

Inversely measured by M. V. of different forms for every color. Values taken from last columns, Tables VIII-XIII. Rank orders of effectiveness in parentheses.

Obs.:		B	D	F	M	P	Av. for All obs.	B (revised)
For the 7 forms in:	R	4.37 (1)	2.47 (2)	6.33 (4)	5.80 (6)	7.10 (5)	5.21 (4)	3.21 (1)
	O	7.24 (5)	6.08 (4)	8.29 (7)	4.14 (3)	7.43 (7)	6.64 (5)	
	Y	6.98 (4)	8.96 (7)	8.24 (6)	6.49 (7)	7.35 (6)	7.59 (7)	4.92 (4)
	G	4.50 (2)	7.00 (5)	3.39 (1)	4.04 (2)	2.79 (1)	4.34 (1)	3.51 (2)
	C	5.68 (3)	5.02 (3)	6.10 (2)	3.22 (1)	3.04 (2)	4.61 (2)	3.80 (3)
	B	7.64 (7)	1.79 (1)	6.24 (3)	4.37 (4)	5.18 (3)	5.04 (3)	6.10 (5)
	P	7.33 (6)	7.20 (6)	7.31 (5)	5.39 (5)	6.08 (4)	6.66 (6)	.... ..
	Av.	6.25	5.50	6.56	4.78	5.57	5.73	4.31

TABLE XVII

RELATIVE EFFECTIVENESS OF SEPARATE FORMS IN CONDITIONING AFFECTIVE TENDENCY OF COLOR-FORM

Inversely measured by M.V. of different colors for every form. Values taken from last rows, Tables VIII-XIII. Rank orders of effectiveness in parentheses.

Obs.:		B	D	F	M	P	Av. for All Obs.	B (revised)
For the 7 colors in:	a	7.26 (3)	10.12 (4)	9.76 (4)	7.96 (2)	7.53 (2)	8.53 (2)	5.52 (4)
	b	6.45 (2)	12.14 (5)	9.94 (6)	9.59 (5)	10.41 (4)	9.51 (6)	4.32 (1)
	c	8.08 (5)	6.86 (1)	9.37 (2)	9.88 (6)	10.04 (3)	8.85 (3)	5.48 (3)
	d	7.53 (4)	7.43 (2)	11.37 (7)	10.16 (7)	10.89 (5)	9.48 (5)	4.84 (2)
	e	5.90 (1)	9.20 (3)	9.76 (3)	9.37 (3)	12.00 (7)	9.25 (4)	5.60 (5)
	f	8.51 (7)	12.71 (7)	6.20 (1)	7.69 (1)	7.20 (1)	8.46 (1)	7.36 (7)
	g	8.49 (6)	12.49 (6)	9.80 (5)	9.57 (4)	11.84 (6)	10.44 (7)	6.16 (6)
Av.		7.47	10.14	9.46	9.17	9.99	9.24	5.61

Dominance of color or form as independently conditioning affective tendency of color-form.—Let us inquire next whether color or form is more dominant in independently conditioning the affective tendency of color-form, and further, as to the relative effectiveness of separate colors and forms in such an operation.

It is evident that if the colors and forms were equally effective, the scatter of the scores of the forms in each color would tend to be equal to that of the colors in each form; and, if colors and forms were unequally effective, the scatter would be different. Again, if any color or form were more effective than the others, the scores of the forms of that color or of the colors of that form would cluster more closely together than the scores of the forms of any other colors or of the colors of any other forms. Obviously, therefore, the effectiveness of each of the seven colors is measured by the M.V. of the scores of the seven forms used in that color. A scale of the relative effectivness of these colors may be based upon the comparison of these M.V's, with effectiveness inversely proportional to the M.V's. In the same way, the effectiveness of each of the seven forms can be measured in terms of the M.V. of the scores of the seven colors used in that form, and a scale similarly constructed for them.

These M.V's have been computed and are indicated in the right-hand columns and in the bottom rows of Tables VIII-XIII. They are reproduced in Tables XVI and XVII with the ranks (in parentheses) of the colors and forms according to their relative effectiveness. On the whole, the colors thus appear more effective than the forms in determining the affective tendencies of the color-forms.

The relative effectiveness of every color and form (Tables XVI and XVII) has been compared with its relative pleasantness (Part II, Instruction I, and Part III, Instruction II) with the following result:

The first three most effective colors are for the observer:
B, the 2 most pleasant and the 1 least pleasant colors.
D, the 2 most pleasant and the 1 moderately pleasant colors.
F, the 1 most pleasant and the 2 least pleasant colors.
M, the 1 most pleasant and the 2 least pleasant colors.
P, the 1 most pleasant and the 2 least pleasant colors.

The first three most effective forms are for the observer:
B, the forms which rank 3, 1, and 6.
D, the 3 most pleasant forms.
F, the 1 most pleasant and the 2 least pleasant forms.
M, the 1 most pleasant and the 1 least pleasant and 1 moderately pleasant forms.
P, the 3 least pleasant forms.

In other words the extremes, *i.e.* the most pleasant and the least pleasant colors and forms, were the most effective. These extremes must represent the most intensive affective degrees, since all observers except B testified that the least pleasant stimuli were actually intensively unpleasant. It appears, therefore, that the dominance of color or form as independently determining the affective tendency of color-form depends directly upon the intensity of its pleasantness and unpleasantness.

Summation of affective tendencies.—We have seen that the high degree of correspondence between the results of Part II and III (attention on color or form alone) and of Part IV (attention on color-form) indicates that both color and form were simultaneously effective in conditioning the pleasantness of a colored form when the attention was directed by instruction upon both the color and form aspects; and that color and form operate simultaneously in conditioning affective judgment in the same manner that each operates when attended to separately. We have seen further that the relative effectiveness of color and form in simultaneous operation is dependent upon the effectiveness of each when operating in attentive isolation. Now to say that color and form thus work independently and simultaneously to establish affective tendency in the way in which each works separately is to state that the two summate. Since we are dealing here with ranks and lack exact measurements of the amount of the affective tendencies involved, we can not, of course, state that summation occurs in any exact arithmetical sense, but the general law that their effects are algebraically additive can not be

denied. Remembering that four of the five observers made judgments at times upon the relative unpleasantness of the stimuli, we may lay down the rule: *Within the dimension of pleasantness and unpleasantness, the affective tendency of color-form varies approximately with the algebraical sum of the affective tendencies of its constituent color and form.*

TABLE XVIII

EFFECT OF DIRECTION OF ATTENTION: PRELIMINARY EXPERIMENT

Preferential order of colors: correlation between ranks for colored squares, and ranks for colors of various forms. (12 obs.; 1st 4 women.)

Obs.:	1	2	3	4	5	6	7	8	9	10	11	12
ρ:	0.97	0.94	0.93	0.97	0.93	0.97	0.89	0.90	0.94	0.99	0.99	0.97

TABLE XIX

EFFECT OF DIRECTION OF ATTENTION: PRELIMINARY EXPERIMENT

Preferential order of forms: correlation between ranks for "neutral" forms, and ranks for forms of various colors. (12 obs.; 1st 4 women)

Obs.:	1	2	3	4	5	6	7	8	9	10	11	12
ρ:	0.86	0.94	0.86	0.96	1.00	1.00	1.00	0.86	0.86	1.00	0.94	0.88

Confirmation by an Experiment under Diffused Daylight.—A comparable result was obtained in a preliminary experiment, which was conducted under uncontrolled diffused daylight but with laboratory conditions otherwise similar to those described above. There were 12 observers, 8 men and 4 women, all of whom except one had had only a little previous training in psychological observation. Color preferences were determined for these observers with a series of colored squares; form preferences were determined by the use of a series of forms outlined in black ink on a grey ground. The results were examined to see whether the judgments given for the 49 colored forms occurred as if dependent upon the concurrent independent summative operation of the tendencies effective in the first two series. As indicated in Tables XVIII and XIX, the co-efficients of correlation between the results on colors and forms and the results on color-forms are, without a single exception, very high for all the observers and support convincingly the conclusion reached in the foregoing analyses.

TABLE XX

AV. REACTION-TIMES (SECS.) FOR ALL COLORS OF EVERY FORM

Form	B	D	F	P	Av. 4 obs.	M
S	2.18	1.05	1.15	0.89	1.32	0.45
a	1.88	1.23	1.05	0.91	1.27	0.49
b	2.15	1.09	0.80	0.91	1.24	0.49
c	1.94	1.17	0.67	0.59	1.09	0.50
d	1.76	1.01	0.76	0.71	1.06	0.44
e	1.71	0.69	0.70	0.66	0.94	0.45
f	1.83	0.92	0.57	0.84	1.04	0.48
g	1.53	0.78	0.53	0.77	0.90	0.47
Av.	1.87	0.99	0.78	0.79	1.11	0.47
M.V.	0.17	0.15	0.16	0.11	0.15	0.02

TABLE XXI

AV. REACTION-TIMES (SECS.) FOR ALL FORMS OF EVERY COLOR

Color	B	D	F	P	Av. 4 - obs.	M
N	2.19	1.05	0.68	1.25	1.29	0.64
R	2.08	0.92	0.73	0.78	1.13	0.60
O	1.19	0.80	0.63	1.05	0.92	0.65
Y	1.00	0.69	0.78	0.95	0.86	0.51
G	1.26	0.90	0.79	0.92	0.97	0.65
C	1.33	0.76	0.60	1.01	0.93	0.57
B	1.21	0.75	0.70	1.11	0.94	0.51
P	1.17	0.79	0.50	0.95	0.85	0.57
Av.	1.43	0.83	0.68	1.00	0.99	0.59
M.V.	0.35	0.10	0.09	0.10	0.16	0.04

TIME-RELATIONS OF AFFECTIVE JUDGMENTS

Speed.—The data indicating the speed of affective judgments are summarized in Tables XX-XXII. They are fairly comparable with the results of Washburn[24] and Nakashima.[25] Miss Washburn and her collaborators found, with a group of thirty observers, that the average of the average reaction times

[24] H. Potter, R. Tuttle, and M. Washburn, The speed of affective judgments, *Amer. J. Psychol.*, 25, 1914, 288-290.

[25] Nakashima, Time relations of affective processes, *Psychol. Rev.*, 16, 1909, 303-339.

for all the judgments of pleasantness on colors taken together was 1.4 secs. The individual averages ranged from 1 to 2.5. For unpleasantness the average was 1.4, ranging from 1 to 2.5. With another group of twenty-five observers, the average of the average reaction times for judgments of pleasantness, exclusive of extreme judgments, was 1.6; the longest individual average for pleasantness was 2.7 secs., and the shortest

TABLE XXII

Av. Reaction-Times (Secs.) for Color-Forms Fractionated to Show Practice-Effects

Series	B	D	F	P	Av. 4 obs.	M
1	1.95	1.17	0.94	1.27	1.33	1.14
2	1.86	0.83	0.74	1.22	1.16	0.79
3	1.74	1.02	0.68	1.40	1.21	0.59
4	1.01	0.97	0.82	1.09	0.97	0.69
5	1.69	0.91	0.66	0.87	1.03	0.60
6	1.61	0.84	0.66	0.88	1.00	0.60
7	1.35	0.84	0.67	1.07	0.98	0.58
8	1.09	1.03	0.57	1.05	0.94	0.59
Av. 1-8	1.54	0.95	0.72	1.11	1.08	0.70
9	1.12	1.63	0.56	1.02	1.08	0.64
10	1.40	0.78	0.57	1.00	0.94	0.71
11	1.38	0.83	0.63	0.82	0.92	0.75
12	1.69	0.67	0.60	0.87	0.96	0.50
13	1.56	0.92	0.54	0.99	1.00	0.57
14	2.01	0.85	0.48	0.84	1.05	0.49
15	1.64	0.87	0.61	0.92	1.01	0.39
16	1.54	0.96	0.58	0.82	0.98	0.40
Av. 9-16	1.54	0.94	0.57	0.91	0.99	0.56
17	1.42	0.82	0.50	0.74	0.87	0.34
18	1.66	0.79	0.50	0.87	0.96	0.38
19	1.56	0.75	0.57	0.70	0.90	0.41
20	1.40	0.84	0.56	0.73	0.88	0.46
21	1.58	0.74	0.52	0.82	0.92	0.45
22	1.27	0.90	0.52	0.72	0.85	0.43
23	1.48	0.76	0.60	0.90	0.94	0.52
24	1.45	0.79	0.48	0.85	0.89	0.50
Av. 17-24	1.48	0.80	0.53	0.79	0.90	0.43
Av. of all	1.52	0.90	0.61	0.93	0.99	0.56
M.V.	0.20	0.12	0.08	0.14	0.14	0.13

0.9 secs. The average for unpleasantness, exclusive of extreme judgments, was 1.6 secs., the longest individual average for unpleasantness was 2.4 and the shortest 0.9. In both cases the speed varied with the intensity of affection. Nakashima by employing the direct reaction method found that the shortest time required for an affection to arise varied from 0.84 to 0.98 secs. for colors; and from 0.72 to 1.08 for geometrical figures. With our observers, the average of all the reaction times for colors is 1.11 secs., for forms, 0.99, and for color-forms, 0.99.[26] There are great individual differences due probably to the difference in attitude and in "affective sensitiveness" of the observers.

We find that the average of the reaction time for the comparisons of the most pleasant color-form with the 24 color-forms that come next in the order of preference (B = 0.80; D = 0.72; F = 0.50; P = 0.61 secs.) is greater than the average of the reaction time for the comparisons of the most pleasant color-form with the 24 least pleasant color-forms (B = 0.74; D = 0.63; F = 0.45; P = 0.45 secs.). It appears, therefore, that the speed of affective judgments under the method of paired comparisons varies with the degree of difference in the intensity or quality of the affective tendencies of the two stimuli compared. A similar relation would doubtless hold with sensory judgments.[27]

Effect of Practice.—The effect of practice is not striking except in the first two or three series. It is overshadowed by the presence of the daily fluctuations of reaction times, which are doubtless caused by the variations in psychophysical conditions determining the general efficiency of the observers. A practice-effect may, however, be made apparent by dividing the 24 series of experiments on color-forms into three groups according to the order in which they were conducted, and by comparing the averages of these reaction times. It will be seen (Table XXII) that these averages become shorter and shorter as they advance from the first to the last groups.

Distribution of reaction times.—The frequencies of reaction times in the experiments on colors, forms and color-forms are much skewed. Starting from the lower end, the distribution curve rises quickly to its maximum and falls slowly with

[26] M's results are excluded from the calculation of these averages, since with her the experiments were performed in the reversed temporal order.

[27] *Cf.* S. S. George, Attitude in Relation to the Psychophysical Judgment, *Amer. J. Psychol.*, 28, 1917, p. 33.

the increase in the length of time. This skew is consistent with the fact that the reaction times are limited in negative deviation since they can scarcely be less than a considerable portion of a second, whereas there is no limitation to the delay that may occur in giving judgment.

Conclusions

I. The preferential orders of colors and forms are relatively permanent during a period extending over five months.

II. When color-forms are presented in some particular form for affective comparisons of colors only, the form has practically no influence upon the preferential orders of these colors.

III. When color-forms are presented in some particular color for affective comparisons of forms only, the color has practically no influence upon the preferential order of forms.

IV. As far as relative pleasantness is concerned, color and form are, in the main, mutually independent in conditioning affective tendency of color-form, even though simultaneously operative.

V. The dominance of color or form as independently determining the affective tendency of color-form probably depends directly upon the intensity of its pleasantness or unpleasantness.

VI. (Corollary of IV and V.) Within the dimension of pleasantness and unpleasantness, the affective tendency of color-form varies approximately with the algebraic sum of the affective tendencies of its constituent color and form.

VII. Two types of affective judgments, characterized by sensorial and objective attitudes, can be made under the method of paired comparisons.

VIII. The reaction times for affective judgments are more rapid in the immediate judgment of the objective attitude than in the mediate judgment of the sensorial attitude, and more rapid when the members compared differ widely in affective degree.

BRENTANO AND WUNDT: EMPIRICAL AND EXPERIMENTAL PSYCHOLOGY[1]

By E. B. Titchener

§ 1. The year 1874 saw the publication of two books which, as the event has shown, were of first-rate importance for the development of modern psychology. Their authors, already in the full maturity of life, were men of settled reputation, fired as investigators with the zeal of research, endowed as teachers with a quite exceptional power to influence younger minds, ready as polemists to cross swords with a Zeller or a Helmholtz. Yet one would look in vain for any sign of closer intellectual kinship between them; hardly, indeed, could one find a greater divergence either of tendency or of training. Psychology, seeing how much their work and example have done to assure her place among the sciences, may gladly confess her debt to both. The student of psychology, though his personal indebtedness be also twofold, must still make his choice for the one or the other. There is no middle way between Brentano and Wundt.[2]

Franz Brentano began his career as a catholic theologian. In 1867 he published an outline of the history of philosophy within the mediaeval church which sets forth, as clearly and sharply as the essay of thirty years later, his famous doc-

[1] The following paragraphs form the introduction to the first volume of my long-projected and long-delayed work upon Systematic Psychology. When I wrote them, Brentano and Wundt were still living. Brentano died at Zurich, March 17, 1917; Wundt died at Leipsic, Aug. 31, 1920.

[2] F. Brentano, *Psychologie vom empirischen Standpunkte* (henceforth cited as *PES*), i, 1874. Cf. the Biographical Note in F. Brentano, *The Origin of the Knowledge of Right and Wrong*, trs. C. Hague, 1902, 119 ff.; M. Heinze, *F. Ueberwegs Grundriss der Geschichte der Philosophie*, iv, 1906, 332 ff. W. Wundt, *Grundzüge der physiologischen Psychologie* (henceforth cited as *PP*), 1874. The first ten chapters of Wundt's work were issued in 1873 and are utilised by Brentano. For a bibliography of Wundt's scientific writings see *Amer. Journ. Psych.*, xix (1908) ff.; cf. Heinze, *op. cit.*, 322 ff.

trine of the four phases.[3] Early and late, however, his intellectual interest has centered in the philosophy of Aristotle. He came to psychology by way of an intensive study of the *De Anima,* and he has made the Aristotelian method his pattern of scientific procedure. We possess, unfortunately, only the first volume of his *Psychologie:* Brentano seems always to have preferred the spoken to the written word: but this volume, like everything else that he has given to the press, is complete in itself, the finished expression of his mature thought.

Wilhelm Wundt started out as a physiologist, interested in the special phenomena of nerve and muscle. In 1862 he had sought to lay the foundations of an 'experimental psychology' (the phrase now appears in print for the first time)[4] in a theory of sense-perception. Here he fell into the mistake to which every student of natural science is liable who turns, without due preparation, to the things of mind: the mistake, namely, of supposing that psychology is nothing more than an applied logic; and the mistake was repeated in a popular work upon human and animal psychology which followed on the heels of the technical volume. By 1874 he had definitely discarded this earlier view for the conception of psychology as an independent science. He still maintained, however, that the path to it leads through the anatomy and physiology of the nervous system.

Such, in briefest outline, were the conditions under which the two psychologies acquired their form and substance. We see, on the one hand, a man who has devoted his 'hours of solitary reflection' to ancient and mediaeval philosophy; we see, on the other hand, a man who has wrought out in the laboratory his contributions to the latest-born of the experimental sciences. They are both professors of philosophy, and they are both to range widely, in the future, over the varied fields of philosophical enquiry. Yet it would be wrong to suppose that the psychology to which they have now attained, and which, by a happy chance, they give to the world in the same year, represents merely an incident, even if it were the central incident, of their philosophical history. Psychology, on the contrary, has laid strong hands upon them, and is to dominate all their further thinking. Wundt, a gen-

[3] J. A. Möhler, *Kirchengeschichte,* ii, 1867, 539 f.; F. Brentano, *Die vier Phasen der Philosophie und ihr augenblicklicher Stand,* 1895. The four phases, repeated in the three great philosophical periods, are those of scientific construction, failure or perversion of the scientific interest, scepticism and mysticism.

[4] W. Wundt, *Beiträge zur Theorie der Sinneswahrnehmung,* 1862, vi.

eration later, will round off the manifold list of his books with the encyclopaedic folk-psychology, and Brentano never gives up the hope of a descriptive—to be followed, perhaps, at long last by a genetic—psychology as the ripe fruit of his studious old age.

§ 2. We shall better understand the nature of this choice which lies before us if we first note the points of resemblance between the two systems. For even in 1874 psychology was not in such bad case that Brentano and Wundt are always at variance. They agree that psychology holds a place of high importance in the fellowship of the sciences, and that it is logically prior to natural science.[5] They agree that it may dispense with the concept of substance and confine itself to an account of phenomena.[6] They reject the unconscious as a principle of psychological explanation.[7] They define the unity of consciousness in substantially the same terms.[8] So far there is agreement: and though the agreement is largely of a formal kind, and though a good deal of it has a negative ground in the reaction against Herbart, it serves nevertheless to mark out a common universe of discourse.

On the material side there is also agreement, with such difference of emphasis as the difference of authorship would lead us to expect. We find, for instance, that Brentano deals at length with the general method of psychology, and is at pains to distinguish inner perception from inner observation, while Wundt takes inner observation for granted and describes in detail only those special procedures which raise it to the rank of experiment.[9]. We find that Wundt devotes much space to Fechnerian psychophysics, and interprets the psychophysical law as a general psychological law of relativity, while Brentano makes only incidental and critical mention of Fechner's work.[10] The differences are striking enough, but behind them lies agreement regarding the subject-matter of psychology. Even in the extreme case, where the one book emphasises what the other omits, difference does not of necessity mean disagreement. We find, again, that Wundt says nothing of a question which for Brentano is the essential problem of psychology as it was the first problem of psychophysics, the question of 'immortality,' of the continuance of our mental life after death, and conversely that Brentano fails

[5] *PES*, 24 ff., 119; *PP*, 4, 863.
[6] *PES*, 10 ff.; *PP*, 9, 12, 20.
[7] *PES*, 133 ff.; *PP*, 644 f., 664, 708 f., 712, 790 ff.
[8] *PES*, 204 ff.; *PP*, 715 ff., 860 ff.
[9] *PES*, 34 ff., 184; *PP*, 1 ff.
[10] *PP*, 421; *PES*, 9 f., 87 ff.

to discuss Wundt's cardinal problem of attention. Yet Wundt had touched upon the question of immortality in his earlier writing, and Brentano plainly recognises that there is a problem of attention, although (as we may suppose) he has put off its discussion to his second volume.[11]

So the student of psychology who read these two books in their year of issue might, if he had made due allowance for the training and natural tendencies of the authors, have entertained a reasonable hope for the future of his science; and we ourselves, who see their differences far more plainly than was possible for him, may still hope that the main issue can be taken on common ground and fought out at close quarters.

§ 3. Brentano entitles his book 'psychology from the empirical standpoint,' and Wundt writes 'physiological psychology' on his title-page and suggests 'experimental psychology' in his text.[12] The adjectives do not greatly help us. For all experimental psychology is in the broad sense empirical, and a psychology which is in the narrow sense empirical may still have recourse to experiment. To show the real difference between the books, the difference that runs through their whole texture and composition, we need at this stage terms that are both familiar and clear; the time has not yet come for technicalities and definitions. We may say, as a first approximation, that Brentano's psychology is essentially a matter of argument, and that Wundt's is essentially a matter of description.

At the end of his discussion of method Brentano refers with approval to Aristotle's use of *aporiae*, of difficulties and objections, wherein a subject is viewed from various sides, and opinion is weighed against opinion and argument against argument, until by comparison of pros and cons a reasonable conclusion is reached.[13] This is, in the large, his own way of working. He appeals but rarely, and then only in general terms, to facts of observation. His rule is to find out what other psychologists have said, to submit their statements to a close logical scrutiny, and so by a process of sifting to pre-

[11] *PES*, 17 ff., 32 f., 95 f.; Wundt takes up the question of immortality (indirectly, it is true) in *Vorlesungen*, etc., ii, 1863, 436, 442; cf. the direct treatment in the later edition, 1892, 476 ff. Brentano recognises the problem of attention in *PES*, 91, 155; cf. 263, and C. Stumpf, *Tonpsychologie*, i, 1883, 68; ii, 1890, 279 f.

[12] *PP*, 3.

[13] *PES*, 96 f.; cf. J. S. Mill, Grote's Aristotle, *Fortnightly Rev.*, N. S. xiii, 1873, 48 ff. Brentano had earlier noted, with the same approval, the use of *aporiae* by Thomas Aquinas: see J. A. Möhler, *Kirchengeschichte*, ii, 1867, 555.

pare the reader's mind for a positive determination. When the ground has thus been cleared Brentano's doctrine, novel though it may be, has the appearance (so to say) of a necessary truth; we feel that we have duly considered the possibilities in the case and have come to the one rational decision; and if for conscience' sake we go on to deduce and to verify, we still are assured beforehand that everything will fit together within the system. Minor points may need to be expanded; even, perhaps, in the light of further *aporiae*, to be corrected; but the whole exposition gives the impression of finality.[14] It is no wonder, then, that many students have judged the author successful in his aim of writing, not Brentano's psychology, nor yet a national psychology, but—psychology.[15]

Wundt's book, on the contrary, abounds in facts of observation: anatomical facts, physiological facts, results of psychophysical and psychological experiment. Its introductory chapter is brief to the point of perfunctoriness, and criticism of psychological theories is packed away into fine-print paragraphs that, to all intents and purposes, are a series of appendices. There is, to be sure, a great deal of argument. Where the facts are scanty, they must not only be generously interpreted but must also be eked out by hypothesis; if a leading physiologist has mistaken the problem of sense-perception,

[14] I know of only three corrections that Brentano has made to his psychology. (1) In *PES* 292 degree of conviction, as intensity of judgment, is declared analogous to degree of intensity of love and hate (cf. 203); in the notes to *The Origin of the Knowledge of Right and Wrong* (1889), 1902, 52 f., this analogy is denied. (2) In *PES* 202 f. feeling is said to be always present along with ideation; the belief to the contrary is due to the mistaken preference of memory over inner perception (44); but in *Untersuchungen zur Sinnespsychologie*, 1907, 119, 124, the acts of the two higher senses are not intrinsically emotive. (3) In *PES* 115 the object upon which a psychical phenomenon is directed is not to be understood as *eine Realität*; but the notes appended to the reprinted section *Von der Klassifikation der psychischen Phänomene* (1911, 149) lay it down that "nie etwas anderes als Dinge, welche sämtlich unter denselben Begriff des Realen fallen, für psychische Beziehungen ein Objekt abgibt."—There would, no doubt, if the book were rewritten, be many other modifications of detail, and yet others if the second volume were undertaken; the discussion of the modi of ideation in the *Klassifikation* shows that Brentano had not in 1874 thought out the doctrine of his Bk. iii. In the main, nevertheless, the doctrine of 1874 has stood the test of Brentano's own continued reflection and of the attacks of critics.

Such an achievement is worthy of all admiration. Only we must add—those of us who challenge Brentano's premises—that even isolated changes are disconcerting. The first statement is so serenely confident, and the changes are again so confidently made!

[15] *PES*, vi.

he must be argued into a better way of thinking; in any case, the new science of experimental psychology must offer a bold front to her elder sisters.[16] The argument, none the less, is always secondary and oftentimes plainly tentative; so that the book as a whole gives the impression of incompleteness, of a first essay which can be improved when more work (and a great many suggestions of further work are thrown out[17]) has been accomplished. Hence it is no accident, but rather a direct reflex of the spirit in which the authors approached their task, that Brentano's volume still bears the date 1874 while Wundt's book, grown to nearly triple its original size, has come to a sixth edition.[18]

This thorough-going difference of argument and description means, of course, a radical difference of attitude toward psychology itself. It means that Brentano and Wundt, in spite of formal and material agreement, psychologise in different ways. Our next step, therefore, is to place ourselves inside the systems and to realise, so far as we may without too much detail, what manner of discipline they intend psychology to be. We have to choose: and the illustrations that follow will show the alternatives of choice in concrete and tangible form.

§ 4. Brentano defines psychology as the science of psychical phenomena. The term may easily be misleading: for the phenomena in question are very far from being static appearances. Generically they are activities; in the individual case they are acts. Hence they can properly be named only by an active verb. They fall into three fundamental classes: those, namely, of Ideating (I see, I hear, I imagine), of Judging (I acknowledge, I reject, I perceive, I recall), and of Loving-Hating (I feel, I wish, I resolve, I intend, I desire). We may use substantives if we will, and may speak of sensation and idea, memory and imagination, opinion, doubt, judgment, joy and sorrow, desire and aversion, intention and resolution; but we must always bear in mind that the psychical phenomenon is active, is a sensing or a doubting or a recalling or a willing.

It is true that we never have act without content. When we ideate, we sense or imagine something; when we judge,

[16] *PP*, Vorwort.

[17] *PP*, 284, 293, 314, 317, 373, 394, 399, etc., etc.

[18] See the prefaces to the successive editions of the *PP*. Even the sixth edition, as I have shown elsewhere (*Psych. Rev.*, xxiv, 1917, 52 f.), has not attained to systematic completion, and only in the fifth (*PP*, i, 1902, ix) did Wundt set himself definitely to the task of system-making.

we perceive something, acknowledge the truth of something, recall something; when we love or hate, we take interest in something, desire or repudiate something. This, however, is precisely the difference between psychical and physical phenomena. The latter are blank and inert: the color or figure or landscape that I see, the chord that I hear, the warmth or cold or odor that I sense, the like objects that I imagine, all these things are described when their given appearance is described; their appearance sums them up and exhausts them; they have no reference, and do not carry us beyond themselves. Psychical phenomena, on the other hand, are precisely characterised by relation to a content, by reference to an object; they contain an object intentionally within them; and this character of immanent objectivity, in virtue of which they are active, marks them off uniquely from the physical phenomena upon which they are directed or toward which they point. Even in cases where the content of a psychical phenomenon is not physical, but is another psychical phenomenon, the distinction holds good. For the act which becomes content or object of another act is not thereby deprived of its essential character; it is still active in its own right; and it is therefore by no means confusable with bare physical appearance.[19]

These are Brentano's views of the subject-matter of psychology. He begins by considering the alleged differences between physical and psychical, finds an adequate *differentia* of the psychical, and is therefore able to define psychology in terms of the matter with which it deals. He then reviews the principal classifications hitherto made of psychical phenomena, and arrives at a classification of his own, in which judgment is accorded independent rank, and feeling and will are bracketed under a single heading. Throughout the discussion his chief reliance is upon argument. To be sure, he takes the testimony of inner perception; but inner perception is not observation; it is rather a self-evident cognition or judgment; and as such it is, if we may use the phrase, of the same stuff as argument.[20] Psychological observation is possible for Brentano only when past acts are recalled in memory; then indeed, as he admits, even a sort of experimentation becomes possible. Not only, however, is memory subject to gross illusion, but the act of memory, once more, falls under the category of judgment, so that experiment itself takes place in the world

[19] *PES*, 23 f, 35, 101 ff, 161, 167, 256 ff. On the problem of natural science as an explanatory discipline, see 127 ff.

[20] *PES*, 35 ff, 181 ff (summary 202 f), 262. Cf. *Klassifikation*, 1911, 129.

of argument.[21] The empirical psychology thus employs the same psychical activities to establish the nature of its subject-matter and to discuss the variety of psychological opinion.

§ 5. For Wundt, psychology is a part of the science of life. Vital processes may be viewed from the outside, and then we have the subject-matter of physiology, or they may be viewed from within, and then we have the subject-matter of psychology.[22] The data, the items of this subject-matter, are always complex, and the task of experimental psychology is to analyse them into "the elementary psychical processes." If we know the elements, and can compare them with the resulting complexes, we may hope to understand the nature of integration, which according to Wundt is the distinguishing character of consciousness.[23]

Analysis of the processes of the inner life brings us, in the last resort, to pure sensations, constituted originally of intensity and quality. Sensations carry no reference; they look neither before nor after; they tell us nothing of their stimuli, whether external or organic, and nothing of their point of excitation, whether peripheral or central, nor do they forecast the ideas in which we find them synthetised. They simply run their course, qualitatively and intensively, and may be observed and described as they proceed.[24] Ideas, in their turn, are originally constituted of these sensations; there is nothing within or upon them to show whether they are ideas of imagination or perceptions.[25] Individual ideas differ psychologically from general ideas solely in the nature of their sensory constituents: in the former the complex of sensations is constant, in the latter it is variable.[26] Concepts are not "psychical formations" at all; if we psychologise them, we discover only their substitutes in consciousness, spoken or written words, accompanied by a vague and indeterminate feeling.[27] Judgments, in the same way, belong to logic, and not primarily to psychology; logic and psychology approximate only as a result of the parallel growth, long continued, of conceptual thinking and its expression in language; our "conscious psychological

[21] *PES*, 42 ff, 162, 169, 262; *Klassifikation*, 130.
[22] *PP*, 1 ff.
[23] *PP*, 5, 20, 717.
[24] *PP*, 273 ff., 484 f. When sensations enter into connection with one another, the third attribute of affective tone or sensory feeling is added. Intensity and quality are, however, the "more original" constituents.
[25] *PP*, 464 f.
[26] *PP*, 468.
[27] *PP*, 672.

processes" consist originally of nothing more than ideas and their connections.[28]

The trend of all this analysis is clear: Wundt is trying to describe mind, to show the stuff of which it is made, to reduce it to its lowest terms. When, however, he turns from analysis to synthesis, the exposition is less easy to follow. Sensations are integrated into ideas by a "psychical synthesis" which Wundt himself compares to a chemical synthesis and which critics have assimilated to Mill's "mental chemistry."[29] Ideas gain their objective reference by a "secondary act" which seems to consist, psychologically, in the simple addition of further ideas;[30] yet the objective reference is itself put, later on, to psychological purposes. Concepts and forms of intuition are made 'postulates' of advancing thought,[31] as if the logical and practical aspects of mind were necessarily implied in its given or phenomenal aspect, and as if the psychologist might shift from one aspect to another without breach of scientific continuity. But though we may puzzle over details, there is nothing obscure in the general situation. Wundt, like many others of his generation, is dazzled by the vast promise of the evolutionary principle;[32] 'original' is for him more or less what 'nascent' is for Spencer; the later must derive from the earlier, because that is the way of things, and the later has no other basis. Let us remember, all the same, that Wundt's primary effort is to describe, and that he falls back upon 'genetic explanation' only when some phase of the traditional subject-matter of psychology proves to be indescribable.

That, then, is one of the threads of Wundt's system. Even a descriptive psychology cannot, however, be written simply in terms of sensations and their modes and levels of psychological integration. For the field of consciousness, Wundt reminds us, is not uniformly illuminated; it shows a small bright area at its centre and a darker region round about; the ideas which occupy it differ in their conscious status. So arises the problem of attention. Descriptively—Wundt takes up the task of description piecemeal, in different contexts, as

[28] *PP*, 709 ff.

[29] *PP*, 484 f; J. S. Mill, *A System of Logic*, 1843, bk. vi, ch. iv (ii, 1856, 429); *An Examination of Sir William Hamilton's Philosophy*, 1865, 286 f; note in J. Mill, *Analysis of the Phenomena of the Human Mind*, i, 1869, 106 ff. The original source is D. Hartley, *Observations on Man*, 1749, pt. i, ch. i, sect. 2, prop. 12, cor. 1 (i, 1810, 77 f.).

[30] *PP*, 465.

[31] *PP*, 672, 680.

[32] *PP*, vi.

if it were 'on his conscience'—attention reduces to clearness of ideas and characteristic feelings of effort or strain.[33] It has two concrete manifestations, apperception and voluntary action; we speak of apperception when we are considering the internal course of ideas, and of voluntary action when we are considering the issue of an emotion in external movement.[34] Both forms of the attentional process are subject to conditions, and both are strictly correlated with physiological processes in the cerebral cortex; they therefore fall within the limits of a scientific psychology.[35] Yet psychologists have neglected them, and have paid the penalty of this neglect in inadequate psychology and untenable philosophy.[36]

We need not here trace the doctrine of attention further; we need not either debate whether the problem of attention is included in Wundt's formal statement of the task of experimental psychology. We may, however, as an illustration of the interweaving of the two systematic threads, glance at his treatment of the association of ideas. He begins, as we might expect, with mode of integration; and under this heading declares that the recognised laws, of similarity and of frequency of connection in space and time, are imperfect even as empirical generalisations. We find, it is true, two forms of association, distinguishable in the free play of fancy and in reflective thought. But the one is wider than association by similarity, in that the effective resemblance may reside in any and every sensory constituent of the ideas concerned, and especially in their affective tone, while the other reveals itself simply as an affair of habit. Wundt therefore proposes to term them, respectively, 'association by relationship' and 'association by habituation.' The new names, he maintains, are not indifferent; for they do fuller justice than the old to the facts of self-observation, and they also point us to the conditions of association in the central nervous substance.[37]

Here then is an improvement on the side of analysis and synthesis; but that is not enough. For ideas do not associate automatically, as it were of their own motion; the laws of association are, on the contrary, under the universal dominance of attention. And now there opens up, for experimental attack, a whole series of special problems which an empirical psychology, following only the single line of enquiry,

[33] *PP*, 717 ff., esp. 724.
[34] *PP*, 831, 835.
[35] *PP*, 720 f., 723 f., 834 f.
[36] *PP*, 792 f., 831 ff.
[37] *PP*, 788 ff.

must naturally miss. In their light we pass beyond associationism to a more faithful transcript of the 'course and connection of ideas';[38] and in like manner we avoid, in our psychology of will, the philosophical *impasse* of indeterminism.[39]—

These paragraphs express, in rough summary, the teaching of the Wundt of 1874. He does not give psychology a distinct and peculiar subject-matter; the difference between physiology and psychology lies simply in our point of view. Wundt had already published a comprehensive work upon physiology, and now that he has turned to psychology he carries his knowledge and method with him; he is convinced that the processes of the inner life are best set forth in close connection with those of the outer life, and that the results of inner observation are surest when the appliances of external observation, the procedures of physiology, are pressed into psychological service. He spends little time upon preliminaries, but gets as quickly as may be to the exposition of facts. Where facts are few or lacking, he seeks to supplement or to supply them by observations of his own. His primary aim in all cases is to describe the phenomena of mind as the physiologist describes the phenomena of the living body, to write down what is there, going on observably before him: witness his treatment of idea, of concept, of attention, of association. There is still great space for argument, and the argument, we must admit, is often influenced by previous habits of thought, by psychological tradition, by a certain tendency to round things off to a logical completeness, by a somewhat naïve trust in the principle of evolution. The argument, however, does not impress the reader as anything but secondary: Wundt is at once too dogmatic and too ready to change his views. The recurring need of further facts and the patchwork character of the argument suggest, both alike, that psychology, under his guidance, has still a long systematic road to travel.

§ 6. We have now viewed our two psychologies from within. Brentano, we have found, looks back over the past, weeds out its errors with a sympathetic hand, accepts from it whatever will stand the test of his criticism, and organises old truth and new into a system meant, in all essentials, to last as long as psychology shall be studied; Wundt, after he has acknowledged his debt to the past, turns away from it and plunges into the multifarious and detailed work of the laboratories, producing a psychology that is as much encyclo-

[38] *PP*, 793; cf. the earlier sections of ch. xix.
[39] *PP*, 837 f.

paedia as system, and that bears on its face the need for continual revision. Which of the two books holds the key to a science of psychology?

Brentano has all the advantage that comes with historical continuity. His doctrine of immanent objectivity goes back to Aristotle and the Schoolmen, and the classification of psychical acts into ideas, judgments, and phenomena of love and hate goes back to Descartes.[40] More than this: he can claim kinship with every psychologist, of whatever school, who has approached his subject from the technically 'empirical' standpoint. For the 'empirical' psychologist means to take mind as he finds it; and like the rest of the world, who are not psychologists, he finds it in use; he finds it actively at work in man's intercourse with nature and with his fellow-man, as well as in his discourse with himself. Terms may change and classifications may vary, but the items of classification are always activities, and the terms employed—faculties, capacities, powers, operations, functions, acts, states—all belong to the same logical universe. Brentano, innovator though he is, takes his place as of right in a great psychological community.[41]

To offset this advantage, and to justify his own break with tradition, Wundt holds out the promise of an experimental

[40] *PES*, 115 f.; *The Origin of the Knowledge of Right and Wrong*, 47.

[41] In spite of the remarks in §3 and in §6 below it may seem unjust to Brentano if, even in this preliminary sketch of the psychological issue, his interest in experiment is left without record. We note, then, that as early as 1874 he urged the establishment at Vienna of a psychological laboratory (*Ueber die Zunkunft der Philosophie*, 1893, 47 f.); that he has published *Untersuchungen zur Sinnespsychologie* (1907) and in particular that he brought the Müller-Lyer illusion to the attention of psychologists (*Zeits. f. Psych. u. Phys. d. Sinnesorgane*, iii, 1892, 349); and that Stumpf, who was his pupil (Ueberweg-Heinze, iv, 1906, 334 f.), has given us the experimental *Tonpsychologie*. All this, however, does not prevent his being, in the narrow sense, an 'empirical' psychologist. Stumpf tells us that his own work is to "describe the psychical functions that are set in action by tones" (*Tonpsych.*, i, 1883, v) and declares later that "there cannot be a psychology of tones; only a psychology of tonal perceptions, tonal judgments, tonal feelings" (*Zur Einteilung der Wissenschaften*, 1907, 30). Brentano, even with a laboratory, would not have been, in Wundt's sense, an 'experimental' psychologist. We know, besides, something of Brentano's systematic programme. The empirical psychology is not to be concluded; it is to be supplemented and replaced by a 'descriptive' psychology (*The Origin*, etc., vii, 51 f.), fragments of which have appeared in *The Origin of the Knowledge of Right and Wrong* (dealing with the phenomena of love and hate and, in the Notes, with judgment) and in the *Untersuchungen* sense-perception). This in turn is to be followed by an explanatory' or 'genetic' psychology, a sample of which is given in *Das Genie*, 1892 (see *The Origin*, etc., 123).

method. He should have been more explicit: for technology as well as science—medicine as well as physiology, engineering as well as physics—makes use of experiment. His actual purpose, as we trace it in the chapters of his book, is to transform psychology into an experimental science of the strict type, a science that shall run parallel with experimental physiology.[42] He failed, no doubt, to see all that this purpose implied, and his earlier readers may be excused if they looked upon his work as an empirical psychology prefaced by anatomy and physiology and interspersed with psychophysical experiments. There is plenty of empirical psychology in the volume. If, however, we go behind the letter to the informing spirit; if we search out the common motive in Wundt's treatment of the familiar topics; if we carry ourselves back in thought to the scientific atmosphere of the seventies, and try in that atmosphere to formulate the purpose that stands out sharp and clear to our modern vision; then the real significance of the *Physiological Psychology* cannot be mistaken. It speaks the language of science, in the rigorous sense of the word, and it promises us in this sense a science of psychology.

But Brentano also speaks of a 'science' of psychology. Which of the two authors is in the right?

[42] The substitution of folk-psychology for experiment in the study of the more complicated mental processes appears in the fourth edition (*PP*, i, 1893, 5); the reservation in regard to psychophysical parallelism in the fifth edition (*PP*, iii, 1903, 775 ff.).

A PRELIMINARY STUDY OF THE RANGE OF VISUAL APPREHENSION

By SAMUEL W. FERNBERGER, University of Pennsylvania

Writers of psychological textbooks usually state that from four to six objects may be apprehended in a single grasp of attention.[1] It is not often that the range of attention is supposed to be greater than six, although a recent text states: "Under ordinary conditions from 6 to 8 objects are clearly distinguished simultaneously. The number may be increased with practice to about 15."[2] The emphasis upon the number six is derived from the pre-experimental work of Sir William Hamilton and his predecessors, but the later experiments seem not to have altered it.[3]

When one examines these measures of the so-called range of attention, however, one finds that the concepts are neither clear nor exact. The usual textbook statement would lead one to believe that all groups up to, say, 4, 5 or 6 objects are invariably capable of being apprehended correctly and that there is no way of assuring correct apprehension of a greater number. Nothing could be further from the case. Take Jevons' early results.[4] He threw at random a few beans

[1] E. B. Titchener, *A Beginner's Psychology*, 1915, 103; J. R. Angell, *Psychology*, 1904, 81; C. S. Myers, *A Text-book of Experimental Psychology*, 1911, 321; W. B. Pillsbury, *The Fundamentals of Psychology*, 1916, 247; R. M. Yerkes, *Introduction to Psychology*, 1911, 297.

[2] H. C. Warren, *Human Psychology*, 1919, 251.

[3] Sir W. Hamilton, *Lectures on Logic and Metaphysics*, 1859-60, I, 253 f. For a survey of the experimental work cf. J. McK. Cattell, *The Inertia of the Eye and Brain*, *Brain*, VIII, 1886, 248-404; B. Erdmann & R. Dodge, *Psychologische Untersuchungen über das Lesen*, 1898; G. M. Whipple, The Effect of Practice Upon the Range of Visual Attention and of Visual Apprehension, *Jour. of Ed. Psychol.*, I, 1910, 249-262; F. N. Freeman, Untersuchungen über den Aufmerksamkeitsumfang und die Zahlauffassung bei Kindern und Erwachsenen, *Päd. Psychol. Arbeit.*, 1910, 88-168; J. Zeitler, Tachistoskopis. Versuche über das Lesen, *Philos. Stud.*, XVI, 1900, 380-463.

[4] W. S. Jevons, The Power of Numerical Discrimination, *Nature*, III, 1871, 281 f. It will be noted that Jevons' results are very incompletely quoted by W. James, *The Principles of Psychology*, 1890, I, 406. James quotes only the results for the first four stimuli, namely, 3, 4, 5, and 6, while Jevons used stimuli up to 15 beans. The results as quoted by James are misleading.

into a box and sought at a glance to estimate their number. His results, thrown into the form of relative frequencies, are as follows:

Number of Beans	Per Cent. Correct Judgment
3	100
4	100
5	96
6	82
7	73
8	56
9	62
10	43
11	38
12	42
13	23
14	28
15	18

Jevons uses as the measure of the discrimination 100 *per cent* correct judgments and concludes that his limit is between 4 and 5 beans.

Cattell's experiments in the Wundtian laboratory yield the following results.

	Per Cent. Correct Judgment			
Number of Objects Exposed	Lines	Digits	Letters	Short Words
2				60
3		90	87	23
4	90	74	63	
5	75	60	36	
6	75	34	23	

But here one cannot accurately use 100 *per cent* correct judgments as the measure of apprehension, because the experiments do not include those small values of the stimulus that would give the highest frequencies. One might extrapolate the function to 100 *per cent* if the frequencies indicated the exact nature of the curve.

In view of these facts, it appears that the statistical limen or threshold, used in the work on sensation and perception, is a more reliable and more readily determined measure of the so-called range of attention. The threshold is defined as that value of stimulus the sensing of which has a probability of 0.5; or that value of stimulus which is as likely to be sensed as not. The problem of the range of apprehension presents, statistically, the same problem as does the terminal limen for sensation. In the case of sensation, one is interested in determining, let us say, the value in wave-frequency of the tone

which is sensed just half of the time and which is so high that it is just not sensed half of the time. Similarly, in the range of apprehension, one is interested in determining the number of objects, the correct apprehension of which has a probability of 0.5. The use of the psychophysical procedure in this case not only yields a measure of the range of apprehension that has a maximum degree of precision, but also ordinarily provides a measure of the degree of precision. It is curious that investigators, working outside the field of sensation, have not oftener used the tools of psychophysics that have been so highly developed for sensation. Williams[5] made such an application when he calculated an associative limen by means of the method of constant stimuli, but the extension is unusual.

Jevons' results, although they involve three inversions, can nevertheless, for purposes of rough comparison, be treated by the method of constant stimuli. For his data the limen is 10.28 beans and the coefficient of precision is 0.143,—a statement that is much more definite than Jevons' conclusion: "The limit of complete accuracy, if there were one, would be neither 4 nor 5, but half-way between them; but this is a result as puzzling as one of the uninterpretable symbols in mathematics, just, for instance, like the factorial of a factorial number. But I give it for what it may be worth."[6]

It must be remembered that this threshold will ordinarily be expressed in fractions of an object, even though it is not possible to prepare a fractional number of objects, of which the correct apprehension has a probability of 0.5. The limen is a *statistical limen,* a calculated quantity which summarizes observed results for purposes of scientific comparison. When one finds the upper threshold of tone to be, say, 18,264 *vs.,* one does not seek to construct a stimulus for this frequency in order to see whether it will give 50 *per cent* positive judgments. One is satisfied with the computed limen as part of a statistical account of observations already made.

The present paper presents some preliminary determinations of a limen of visual apprehension.[7] The stimuli were circular dots, 5 mm. in diameter. Four to twelve dots were arranged on cardboards in a haphazard order. Each group fell entirely within the range of foveal vision. These cards were exposed

[5] H. D. Williams, On the Calculation of an Associative Limen, *Amer. Jour. of Psychol.,* XXIX, 1918, 219-226.

[6] Jevons, *op. cit.*

[7] These experiments were performed in the Laboratory of Experimental Psychology at Clark University during the spring of 1920.

by means of a Whipple tachistoscope.[8] A pre-exposure fixation point was used. The subject was seated at a distance of 2.5 m. from the apparatus.

Three series of stimuli were employed. They were:

Series I. Black dots on white background with an exposure time of 100 sigma.

Series II. Black dots on a medium-grey background with an exposure time of 100 sigma.

Series III. Black dots on a white background with an exposure time of 60 sigma.

By comparing Series I and III we hoped to study the effects of the speed of exposure. By comparing the results of Series I and II we hoped to study the effect of the brightness of the stimulus.

Five subjects were employed. They were L. D. Boring, Ph. D. (Ob. B), C. C. Pratt, A. M. (Ob. P), S. Yokoyama, A. M. (Ob. Y), M. Bates, A. M. (Ob. Ba) and J. H. Alston, A. M. (Ob. A). The instructions were: "You will be shown successively, for a very short exposure, cards which will contain a varying number of black dots on a white (or grey) background. Immediately after the exposure you will report verbally the number of dots which you have apprehended. Be sure of your judgment and do not guess. The report 'I do not know' is admitted."

The judgments were recorded either as 'correct' or 'not correct.' Seven cards were shown in each series, four to ten dots to Obs. P, Ba and A; six to twelve dots to Obs. B and Y. Nine series of cards were prepared (63 cards in all); each series was shown an equal number of times; and the cards of each series were shuffled after the series had been presented. In Series I (white background, 100 sigma exposure) 250 judgments for each number of dots were obtained from each subject. In Series II (grey background, 100 sigma exposure) 150 judgments were obtained, and in Series III (white background, 60 sigma exposure) 150 judgments were obtained from each subject. The results were fractionated into groups of 50 judgments on each stimulus and each fraction was treated separately by Urban's procedure for the method of constant stimuli.[9]

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[8] For a description of this apparatus cf. G. M. Whipple, *Manual of Mental and Physical Tests*, I, 1914, 264 f.

[9] For a description of this form of mathematical treatment cf. F. M. Urban, Hilfstabellen für die Konstanzmethode, *Arch. f. d. ges. Psychol.*, XXIV, 1912, 236-243.

TABLE I

OB. B.

	Fractions	Number of Dots						
		6	7	8	9	10	11	12
Series I	I	0.96	0.88	0.72	0.58	0.44		
	II	1.00	0.96	0.88	0.52	0.46	0.28	0.12
	III	1.00	0.96	0.84	0.64	0.46	0.28	0.20
	IV	1.00	0.96	0.74	0.58	0.44	0.22	0.22
	V	1.00	0.98	0.84	0.56	0.36	0.18	0.10
	Ave.	0.99	0.95	0.80	0.58	0.43	0.24	0.16
Series II	VI	1.00	0.98	0.86	0.56	0.34	0.22	0.08
	VII	1.00	0.98	0.90	0.60	0.38	0.20	0.10
	VIII	1.00	0.98	0.90	0.74	0.54	0.30	0.12
	Ave.	1.00	0.98	0.89	0.63	0.42	0.24	0.10
Series III	IX	1.00	0.98	0.92	0.74	0.46	0.32	0.16
	X	1.00	1.00	0.92	0.86	0.56	0.32	0.22
	XI	1.00	0.98	0.94	0.74	0.52	0.28	0.18
	Ave.	1.00	0.99	0.93	0.78	0.51	0.31	0.19

TABLE II

OB. P.

	Fractions	Number of Dots						
		4	5	6	7	8	9	10
Series I	I	1.00	0.92	0.84	0.60	0.06	0.00	0.00
	II	1.00	0.98	0.88	0.60	0.04	0.00	0.00
	III	1.00	0.98	0.92	0.48	0.08	0.00	0.00
	IV	0.96	0.88	0.82	0.56	0.08	0.00	0.02
	V	0.96	0.94	0.90	0.64	0.20	0.00	0.00
	Ave.	0.98	0.94	0.87	0.58	0.09	0.00	0.00
Series II	VI	1.00	0.98	0.86	0.62	0.30	0.00	0.00
	VII	0.98	0.96	0.80	0.56	0.06	0.02	0.00
	VIII	0.98	0.94	0.78	0.48	0.16	0.02	0.00
	Ave.	0.99	0.96	0.81	0.55	0.17	0.01	0.00
Series III	IX	0.98	0.96	0.80	0.58	0.24	0.04	0.00
	X	1.00	0.96	0.88	0.68	0.30	0.06	0.00
	XI	1.00	0.96	0.92	0.62	0.28	0.04	0.00
	Ave.	0.99	0.96	0.87	0.63	0.27	0.05	0.00

TABLE III

OB. Y.

	Fractions	Number of Dots						
		6	7	8	9	10	11	12
Series I	I	0.98	0.94	0.86	0.72	0.54		
	II	0.98	0.94	0.90	0.68	0.64	0.42	0.20
	III	1.00	0.98	0.92	0.72	0.56	0.44	0.16
	IV	1.00	0.98	0.92	0.80	0.70	0.50	0.30
	V	1.00	1.00	0.98	0.90	0.72	0.56	0.30
	Ave.	0.99	0.97	0.92	0.76	0.63	0.48	0.24
Series II	VI	1.00	0.98	0.96	0.88	0.74	0.56	0.34
	VII	1.00	0.98	0.94	0.92	0.82	0.54	0.42
	VIII	1.00	0.98	0.94	0.86	0.68	0.48	0.28
	Ave.	1.00	0.98	0.95	0.89	0.75	0.53	0.35
Series III	IX	1.00	0.98	0.92	0.88	0.72	0.48	0.24
	X	1.00	0.98	0.92	0.88	0.78	0.54	0.28
	XI	1.00	0.98	0.96	0.88	0.74	0.56	0.34
	Ave.	1.00	0.98	0.93	0.88	0.75	0.53	0.29

TABLE IV

OB. BA.

	Fractions	Number of Dots						
		4	5	6	7	8	9	10
Series I	I	0.98	0.96	0.90	0.74	0.14	0.00	0.00
	II	1.00	0.96	0.96	0.64	0.12	0.04	0.00
	III	1.00	0.98	0.88	0.68	0.24	0.02	0.00
	IV	1.00	0.96	0.92	0.70	0.22	0.02	0.00
	V	1.00	0.96	0.90	0.72	0.40	0.16	0.02
	Ave.	1.00	0.96	0.91	0.70	0.22	0.05	0.00
Series II	VI	1.00	0.98	0.94	0.76	0.48	0.22	0.02
	VII	1.00	0.98	0.92	0.76	0.46	0.22	0.06
	VIII	1.00	0.98	0.94	0.72	0.48	0.24	0.06
	Ave.	1.00	0.98	0.93	0.75	0.47	0.23	0.05
Series III	IX	1.00	0.96	0.88	0.76	0.42	0.24	0.06
	X	1.00	0.98	0.92	0.74	0.24	0.12	0.04
	XI	1.00	0.98	0.94	0.78	0.38	0.18	0.06
	Ave.	1.00	0.97	0.91	0.76	0.35	0.18	0.05

TABLE V

OB. A.

	Fractions	Number of Dots						
		4	5	6	7	8	9	10
Series I	I	0.68	0.52	0.38	0.22	0.20	0.16	0.10
	II	0.88	0.72	0.50	0.36	0.30	0.16	0.10
	III	0.96	0.88	0.72	0.36	0.34	0.24	0.22
	IV	0.96	0.94	0.68	0.56	0.44	0.24	0.22
	V	1.00	0.94	0.82	0.60	0.42	0.24	0.20
	Ave.	0.90	0.80	0.62	0.42	0.34	0.21	0.17
Series II	VI	1.00	0.98	0.84	0.56	0.36	0.26	0.22
	VII	0.96	0.90	0.78	0.62	0.44	0.28	0.22
	VIII	0.98	0.94	0.80	0.64	0.38	0.20	0.16
	Ave.	0.98	0.94	0.81	0.61	0.39	0.25	0.20
Series III	IX	0.98	0.92	0.78	0.64	0.42	0.26	0.18
	X	1.00	0.98	0.92	0.76	0.56	0.28	0.20
	XI	1.00	0.96	0.92	0.72	0.48	0.28	0.18
	Ave.	0.99	0.95	0.87	0.71	0.49	0.27	0.19

The observed relative frequencies of correct judgments are to be found in Tables I-V, which give for each observer and for every fraction of 50 judgments the relative frequency of correct judgments on every number of dots employed. The averages for each series are averages of the fractions of that series. An examination of these tables shows that we are here dealing with a continuous function. In the case of every group for every observer, the relative frequencies of correct judgments are high for the low values of stimulus and decrease regularly as the number of dots increases. There is not a single inversion in the entire five tables.

These relations become more obvious when the results are thrown into the form of curves. Figure I gives these curves for Ob. Ba. The average relative frequencies (Table IV) of the three series are plotted. The curves resemble the *phi-gamma function,* but are asymmetrical in that the dispersion of the supraliminal portion is less than that of the subliminal part.

The numerical values of the thresholds (S) and of the coefficients of precision (h) are given in Tables VI-X. It will be observed that both the values of the observed relative

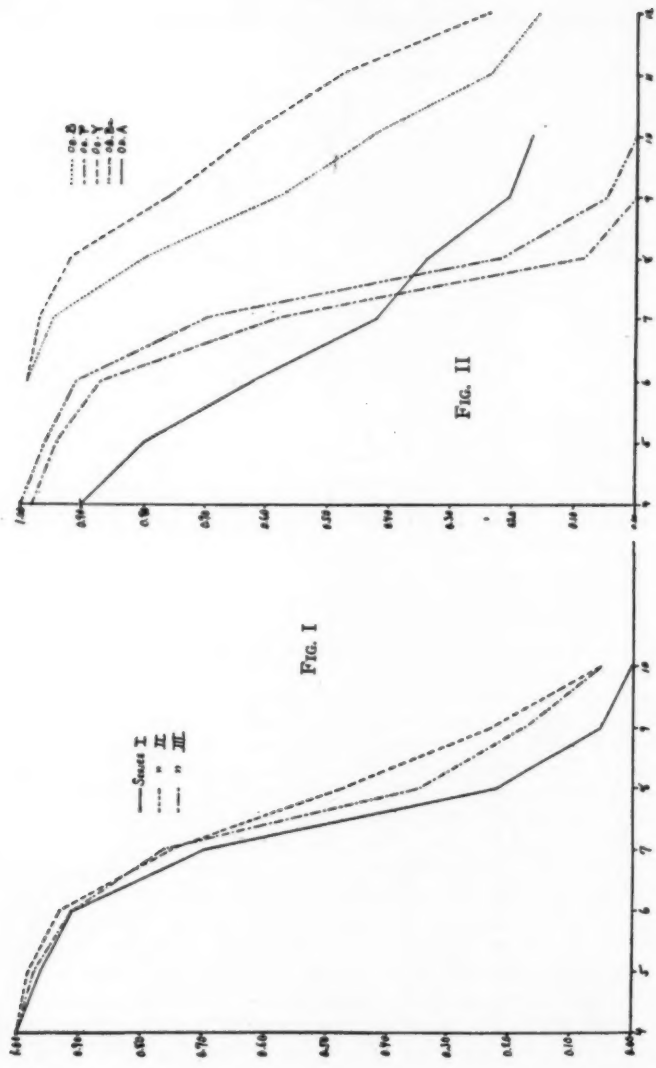

FIG. I

FIG. II

TABLE VI

OB. B.

Fractions	Series I		Series II		Series III	
	h	S	h	S	h	S
I	0.314	9.499	0.441	9.554	0.421	10.140
II	0.385	9.755	0.454	9.683	0.416	10.442
III	0.349	9.969	0.434	10.122	0.429	10.204
IV	0.312	9.695				
V	0.450	9.551				
Ave.	0.362	9.694	0.443	9.786	0.422	10.262

TABLE VII

OB. P.

Fractions	Series I		Series II		Series III	
	h	S	h	S	h	S
I	0.642	6.939	0.586	7.359	0.555	7.097
II	0.862	6.996	0.644	6.864	0.595	7.376
III	0.880	6.942	0.590	6.848	0.640	7.305
IV	0.501	6.883				
V	0.492	7.246				
Ave.	0.675	7.001	0.607	7.024	0.597	7.259

frequencies and those of the coefficients of precision and the thresholds are relatively similar for the different series for each observer. It was expected that the form of the curves might vary for the different series, thus showing the influence of the brightness of the backgrounds and of the length of the exposure times. No such variation is present for any subject.

Probably the effect of practice obscures any slight differences that might otherwise occur between the series. Practice is evident in the higher values of both the threshold and the coefficient of precision. The effect of practice upon the

TABLE VIII

Ob. Y.

Fractions	Series I		Series II		Series III	
	h	S	h	S	h	S
I	0.345	10.204	0.365	11.252	0.390	10.884
II	0.331	10.334	0.342	11.535	0.365	11.126
III	0.389	10.374	0.381	10.912	0.365	11.252
IV	0.341	10.954				
V	0.425	11.138				
Ave.	0.366	10.601	0.362	11.233	0.373	11.087

TABLE IX

Ob. Ba.

Fractions	Series I		Series II		Series III	
	h	S	h	S	h	S
I	0.581	7.282	0.556	7.906	0.469	7.830
II	0.700	7.146	0.518	7.909	0.592	7.565
III	0.700	7.289	0.509	7.934	0.553	7.835
IV	0.687	7.294				
V	0.532	7.650				
Ave.	0.640	7.332	0.527	7.916	0.538	7.743

coefficient of precision is noticeable when the average values of every subject, except Ob. P, are compared. The effect on the thresholds is marked for all subjects, especially for Ob. A. These results accord with former experiments on the effects of practice upon visual apprehension.[10]

[10] G. M. Whipple, The Effect of Practice Upon the Range of Visual Attention and of Visual Apprehension, *Jour. of Ed. Psychol.*, I, 1910, 249-262; K. M. Dallenbach, The Effect of Practice Upon Visual Apprehension in School Children, *Jour. of Ed. Psychol.*, V, 1914, 321-334, 387-404; K. M. Dallenbach, The Effect of Practice Upon Visual Apprehension in the Feeble-Minded, *Jour. of Ed. Psychol.*, X, 1919, 61-82; cf. *Journ. Exp. Psych.*, iii, 1920, 228 f.

TABLE X

OB. A.

Fractions	Series I		Series II		Series III	
	h	S	h	S	h	S
I	0.204	4.974	0.336	7.757	0.338	7.768
II	0.276	6.435	0.303	7.825	0.413	8.276
III	0.290	7.291	0.373	7.660	0.400	8.102
IV	0.299	7.632				
V	0.339	7.776				
Ave.	0.282	6.822	0.337	7.747	0.384	8.049

Figure II gives a comparison of the results for the different observers. The psychometric functions for each subject in Series I are plotted together. The graphs illustrate the relative positions of the thresholds for the five observers. Ob. Y has the highest values, ranging for all of the three series about 11 dots. Next lower are the values for Ob. B, ranging about 10 dots. The values for Ob. Ba are about 7 to 8 dots; those for Ob. A in the neighborhood of 7 to 8 dots; and those for Ob. P are the lowest, being very close to 7 dots.

It seemed also of interest to determine just what were the mental processes underlying the formation of these judgments of visual apprehension. For this purpose, some introspections were obtained from each of the subjects. An analysis of these introspections reveals the following facts.

For Ob. B, the process was essentially one of utilizing the immediate memory after-image after the exposure was completed and of grouping the dots for purposes of apprehension. This grouping was present even for the lower values of stimulus (6 and 7 dots for this subject). The following introspection is typical for this observer:

"This time the judgment came very quickly and was accompanied by an attitude of great subjective certainty. The spot-pattern was very distinct and the dots were very uniformly black and very sharply outlined. After the exposure, there was a visual memory after-image left for a moment after the light had streaked by. The counting in vocal-motor terms began while this was still present. The left part of this image was most distinct and was counted first. Fixation, with accompanying kinaesthesis of effort, of the exposure square persisted until the counting was finished. The counting was in groups with eye-movements from the location of one group to that of the next as I counted."

The process for Ob. P were very rapid and the judgment was reported as having been formed during the time of the actual exposure. Eye-movement did not seem to be present but, even though the exposures were as short as 100 and 60 sigma, there was grouping. This grouping was present, apparently, in shifts of clearness and of focality. The following is a typical introspection:

"When the shutter was removed, there was intensive, but indistinct visual perception of a light and rather extended area. This first immediate visual perception was rapidly followed by a standing-out, with respect to clearness, of the central portion of the area. In this central portion, I perceived focally the three dots (which formed the upper portion of the figure). Then there was a rapid shift in focality in which I perceived very clearly the remaining dots of the figure. There was also vocal-motor imagery, very rapid, telescoped and non-focal, present with the changing focality of the dots, of 'four—seven.' This was then vocalized and general relaxation followed."

Ob. Y's processes were very similar to those of Ob. P. The processes were rapid and the judgment was reported as being completed by the end of the exposure-period. Grouping was present, again in terms of shifts of clearness and focality. The following introspection will illustrate the processes employed:

"I had a clear auditory perception of the 'ready' signal, which was followed immediately by the clear perception of the dots arranged in the form of an uneven square. The attention then shifted to the uper right-hand part of the figure. Rapid perception of four dots which stood out very clearly. Then I had a clear perception of three dots in the lower left-hand part of the figure. Then immediately I had a very clear perception of another group of three dots in the central part of the figure. Then followed the verbalization 'ten' which was followed by intensive pleasantness."

Observers Ba and A were not so highly trained in introspection as were the other subjects. Still their protocols give an insight into the processes present. Ob. Ba employed a process very similar to that reported by Ob. B. A visual memory after-image of the stimulus was present immediately after the exposure. Grouping was present in terms of clearness-shifts in this image. The following introspection illustrates the process employed:

"There was first a perception of the stimulus as a whole, no part of it being any clearer than any other part. This was folowed by a visual memory after-image which lasted only a very short time. Then a true visual image of the stimulus came in. First the left-hand side was clearest and I had a vocal-motor 'four.' Then the right-hand side became clearer and I had a vocal-motor 'three.' Then the entire image became fairly clear and this was immediately followed by the verbalization of 'seven'."

Observer A employed an immediate visual after-image, and grouping was present in terms of clearness-shifts in this image. The following typical introspection is given:

"Immediately after the exposure I had a visual memory after-image of the stimulus. At first three dots in the upper portion of the figure were very clear. This was followed almost simultaneously by a standing-out clearly of two dots in the lower portion of the figure. Then an image in which all five dots were clear and focal came in rather suddenly and gradually faded out. The judgment was then verbalized."

A consideration of these introspections reveals that grouping was always present for all of the observers. The exposure-times which were employed were too brief to admit eye-movements. Still the splitting up of the total stimulus into groups was accomplished by means of shifts of clearness and of focality. The observers may be divided into two distinct types. For Obs. Y and P this grouping of the dots by means of clearness shifts was reported as being accomplished during the actual exposure of the stimulus, and the judgment was completed by the end of the very brief exposure-time. For Obs. B, Ba and A, this grouping took place in a visual memory after-image which appeared immediately after the exposure was completed. One might hope here to discover a basis for the differences in the size of the limen between the different subjects but, unfortunately, the hope is disappointed. The grouping on the side of process is: Immediate type of judgment, Obs. Y and P; use of visual memory after-image, Obs. B, Ba and A. The grouping of subjects on the basis of limen-values is: Higher values, Obs. B and Y; lower values, Obs. Ba, P and A. The groups in the two cases do not agree. Ob. Y, who employed the immediate type of judgment, had the highest limen-values; while Ob. P, who employed the same type of process, had the lowest.

From a consideration of the introspections we are convinced that the range of attention is an erroneous title for this sort of experiment. We have, therefore, followed Whipple and Dallenbach in calling the problem, in this sort of experiment, the range of visual apprehension.

Conclusions

1. The observed relative frequencies of correct judgments in experiments upon range of visual apprehension follow a continuous function of ogive form

2. The statistical limen, that stimulus-value for which correct judgments are given in 50 *per cent.* of the cases, is the most reliable measure of the range of visual apprehension.

3. In our experiments the individual limens for simultaneous visual apprehension ranged from six to over eleven stimulus objects (dots).

EMOTIONS AND INSTINCTS

By Henry C. Link

For many years the instincts have been identified, to a greater or lesser extent, with the emotions. In 1880, G. H. Schneider[1] gave the first developed expression of this identity. James soon after suggested the co-ordination between instinct and emotion in two successive chapters under these titles.[2] But the most ambitious attempt to establish this identity is that made by W. McDougall, who even couples specific emotions with specific reactions.[3] For example, he identifies the emotion of anger with the instinctive reactions of pugnacity, the emotion of fear with the instinct of flight, disgust with repulsion, wonder with the actions of curiosity, the tender emotion with the parental instinct, elation with self-asserting activities. He names other instincts and emotions such as gregariousness, the constructive instinct, and hunger; but these, he says, have no definite corresponding emotion.

The question which all of these views promote is the question as to the character of this identity. First of all, are the emotions and instinctive motor reactions identical in time? It is often stated that they are, and we are sometimes told that the emotions are but the subjective aspect of the instincts. However, the tendency is to regard either one or the other as prior. The James-Lange theory insisted upon the priority of the instinctive response and the subsequent presence of a characteristic emotion. James himself repudiated this view to a certain extent when he admitted that the perception of a total situation, and not a mere physical object, initiated both the emotion and the instinctive response.[4] The extensive experiments of Sherrington, described especially with reference to their bearing upon the James-Lange theory, led him to assert as his theory that the bodily changes and the psychic

[1] G. H. Schneider, *Der thierische Wille*, 66, 96, 1 and 6 ff.
[2] *Principles of Psychology*, vol. ii.
[3] *Social Psychology*, 45 ff.
[4] W. James, "The Physical Basis of Emotion," *Psychological Review*, i, 1894, 523 ff.

factor or the emotion occur concomitantly.[5] Sherrington also says that "of points where physiology and psychology touch, the place of one lies at emotion."[6] Further experiments, made by W. C. Cannon, confirm this theory. Cannon says: "We do not feel sorry because we cry, as James contended, but we cry because when we are sorry or overjoyed or violently angry . . . there are nervous discharges by sympathetic channels to various viscera, including the lachrymal glands."[7] That is, the two are simultaneous as far as time is concerned. In fact, it is difficult to see how one could be found to precede the other. In animals, for example, where, as Sherrington says,[8] we have to infer the character of the emotions from the physical manifestations, it is impossible to say whether one or the other comes first. In ourselves it is impossible to decide because, when our attention is turned to the active side of emotion, we are only secondarily aware of the emotion itself; whereas, when we are most conscious of the emotion, we are only secondarily aware of its motor accompaniments.

Another way in which instincts and emotions are identified is by defining them both as dependent upon the same bodily mechanisms. Each emotion has its corresponding visceral and organic activities and characteristic bodily expression. This, in its most extreme form, is the view held by McDougall, who says: "In the case of the powerful instincts, the affective quality of each instinctive process, and the sum of visceral and bodily changes in which it expresses itself, are peculiar and distinct."[9] However, the experiments of Sherrington and Cannon may be regarded as having disproved this theory. The view that the differentiated features of emotions are due to the viscera was discredited by Sherrington, when he demonstrated that emotional responses occur in dogs in which practically all the main viscera and the great bulk of skeletal muscles have been removed from subjection to and from influence upon the brain, by severance of the vagus and spinal cord. He admits that the visceral reactions strengthen the emotion; they are nevertheless of relatively small importance "as compared with the cerebral reverberations to which is adjunct the psychical component of emotional reaction."[10] In support of this view, W. B. Cannon says: "The evidence which I

[5] *Integrative Action of the Nervous System*, 258.
[6] *Op. cit.*, 256.
[7] W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear, and Rage*, 280.
[8] *Op. cit.*, 266.
[9] *Social Psychology*, 46.
[10] *Op. cit.*, 268.

have given above, as well as that which he (Sherrington) has offered, favors the conclusion that the viscera are relatively unimportant in an emotional complex, especially in contributing differential factors."[11] On the other hand, d'Allonnes[12] points out, very shrewdly, that Sherrington's experiments would upset the peripheral theory only if we could prove that animals actually experience the emotions whose signs they manifest. He himself takes the opposite view, basing his conclusions upon observations on a woman who, having lost her visceral sensibilities of pain, hunger, thirst, and fatigue, exhibited all the signs of anger, fear, chagrin, etc., but at the same time asserted that she did not feel any of these emotions. In this case, the proof hinges upon whether or not we can believe what the subject said.

From the above testimony it must be apparent that the physiological method with animals can never demonstrate what connection exists between emotions and bodily activities. In the first place, it begins with the assumption that certain acts express certain emotions, which in itself is a questionable assumption. In the second place, it concludes that, whenever the characteristic motor expressions are present, as for example the retreat of a dog as if frightened, the emotion is also present, and whenever these motor expressions are absent, the emotion is also absent. Goltz, for example, made experiments upon dogs which showed that when the vascular and visceral fields had been severed from connection with the head, the animal was still able to perceive objects and react to them with the characteristic motor responses of joy, fear, excitement, etc., while the dog whose cerebral hemispheres had been removed was able to respond only to the affective situations of pain and pleasure.[13] What such experiments can prove at the most is that certain characteristic motor or organic reactions are dependent upon certain parts of the nervous or vasomotor system, but they cannot prove that those reactions are invariably connected with the emotions they are supposed to represent.[14]

Watson cuts through this difficulty by discarding, almost entirely, the traditional distinction between instinct and emotion. Instead of regarding emotion as the subjective or psychological aspect of instinct, he regards it simply as a slightly different type of motor response. "Emotion is an hereditary

[11] *Ibid.*, 283.
[12] G. Revault d'Allonnes, *Les inclinations, leur rôle dans la psychologie des sentiments*, 1908, 228 ff.
[13] Sherrington, *op. cit.*, 263, 266.
[14] *Op. cit.*, 266;; E. B. Titchener, *Text Book of Psychology*, 481 ff.

'pattern-reaction' involving profound changes in the bodily mechanism as a whole, but particularly of the visceral and glandular systems."[15] Whereas "instinct is an hereditary pattern-reaction, the separate elements of wihch are movements principally of the striped muscles."[16] Without discussing the refinements of these definitions we easily see that they indicate a radically different conception of the whole subject of emotion and instinct. By defining instinct and emotion both as somewhat different but essentially similar objective phenomena, Watson avoids, for all practical purposes, the many confusions and philosophical speculations which have characterized the studies dominated by the James-Lange point of view. Whether the differentiation he makes will prove valuable is another question. At least we have here a statement which recognizes the futility of the traditional views and sets out on a track which has a fair chance of being proved or disproved objectively.

It seems likely that the attempt to define and classify emotions through introspection can never become more than purely conjectural. The endless variety of opinion which we find among psychologists as to the character and number of the emotions is eloquent testimony to the futility of this procedure. It is the very nature of emotion to connect itself with almost any objective expression whatsoever, and hence, from a subjective point of view, it is hopeless to try to establish even relatively invariable connections between definite reactions and emotions. The tendency for emotions to become more and more diffuse, and to be identified with an ever-increasing range of objects and interests, but confirms this statement. James, although he associated instinctive responses with emotions, clearly recognized this difficulty when he said: "In short, every classification of emotion is seen to be true and natural as any other, if it only serves some purpose; and such a question as 'what is the "real" or typical expression of anger or fear?' is seen to have no objective meaning at all."[17]

In spite of this obvious problem some psychologists have presented classifications of emotions and ascribed to them objective phenomena with a completeness and certainty which is certainly not warranted by the facts. McDougall, for instance, begins with a certain number of innate instinctive emotional dispositions, and upon these as a basis constructs the entire fabric of life as it is found today. "The instinctive impulses," he says, "determine the ends of all activities and supply the

[15] *Psychology from the Standpoint of a Behaviorist*, 195.
[16] *Op. cit.*, 231.
[17] *Psychology*, 381. f.

driving power by which all mental activities are sustained; and all the complex intellectual apparatus of the most highly developed mind is but a means towards these ends, is but the instrument by which these impulses seek their satisfactions."[18] McDougall enumerates a group of primary instincts, about seven in number, each of which he claims is differentiated by a distinct emotional core and a characteristic bodily activity.[19] Upon these instincts, then, he proceeds to build the various institutions, customs, habits, and interests which characterize society. He traces to them the development of morals; of religion; of the higher sentiments of love, hate, and respect; of self-consciousness, volition, ideals; in short, of the whole range of life. A more thoroughgoing psychological rationalism it would be difficult to imagine. The very comprehensiveness of the scheme gives it an increased plausibility, for, having begun with the statement that the instincts are the factors which determine and sustain "all" the activities of life, he has not omitted to catalogue all those activities under some instinct or other.

In the first place, what is the principle by which McDougall distinguishes the primary emotions and instincts? "Each of the principal instincts," he says, "conditions some kind of emotional excitement whose quality is specific or peculiar to it; and the emotional excitement of specific quality that is the affective aspect of the operation of any one of the principal instincts may be called a primary emotion."[20] This principle, McDougall holds, is "of very great value when we seek to analyze the complex emotions into their primary constituents."[21] However, this is merely a postulate or an arbitrary statement of what McDougall intends that an instinct-emotion shall mean. Whether such entities exist, and how we can distinguish them if they do exist, is still the problem. McDougall suggests two principles which he thinks will be of great help in picking out the primary instincts. The first is that "if a similar emotion and impulse are clearly displayed in the instinctive activities of the higher animals, that fact will afford a strong presumption that the emotion and impulse in question are primary and simple."[22] The second principle of discovery is to inquire whether the emotions and instincts in question are subject to morbid hypertrophy or excitability.[23]

[18] *Op. cit.*, 33.
[19] *Ibid.*, 45 ff.
[20] *Ibid.*, 47.
[21] *Ibid.*, 47.
[22] *Ibid.*, 49.
[23] *Ibid.*, 49.

With regard to the first of these criteria, the analysis presented above suggests the trend of our criticism. If, in the first place, we infer the presence and quality of emotions in animals by comparing their attitudes with our own, how can we legitimately infer the number and kind of our own primary emotions by referring them to the analogy which we have created? To create an object by introspection, and then to use it as an objective criterion by which to establish the primal quality of our own emotions, is indeed a vicious circle. Moreover, the claim that "in case of the powerful instincts, the affective quality of each instinctive process and the sum of visceral and bodily changes in which it expresses itself are peculiar and distinct"[24] is not borne out by the facts. Even if it were possible to take the higher animals and base a deduction of the emotions upon the instinctive activities which they manifest, it would still be impossible to draw this inference; for, as the above analysis shows, the motor reactions which characterize certain affective processes are dependent upon visceral disturbances in only a minor degree. As for the second criterion, it seems reasonable to think that if each instinctive emotion is a "relatively independent unity in the constitution of the mind," it would be liable to morbid hypertrophy or abnormal excitement. However, the forms of abnormality display as great a complexity as the forms of normal life, and hence do not offer that decisive individuality which the given definition of instinct would lead one to expect. And if it is difficult to connect typical acts with primary emotions in our own minds, and impossible to do more than conjecture the nature of the connection in animals, how much more difficult is it to connect the disarranged and abnormal activities of an abnormal person with any particular emotion? Psychiatry has succeeded in connecting ideas with ideas, events with events; but it has only partly suggested the exact nature of the connection between specific acts and specific emotions.

The choice of instinctive emotions which McDougall makes clearly bears out the above criticisms. For example, the gregarious instinct, according to McDougall, is not marked with an emotion "sufficiently intense or specific to have been given a name;"[25] nevertheless, he attributes to it the tremendous growth of cities and an immense range of social phenomena. The same may be said of the constructive instinct and the instinct of acquisition. Both of these are responsible, in McDougall's social structure, for a great deal, in spite of the fact that they are not marked by any specific emotion.

[24] *Ibid.*, 46.
[25] *Ibid.*, 86.

On the other hand, joy, which is thought to display itself in one of the most immediate and manifest responses in some of the higher animals,[26] is listed by McDougall among the sentiments. The instincts of subjection and elation which McDougall considers primary are obviously of a questionable character. They are so general that they may be interpreted into almost any situation. Finally, the principle which governs McDougall's choice of instincts is too susceptible to inversion. By that I mean that McDougall is more intent upon reading the facts back into instinct than upon reading the facts out of the instincts. Given a certain class of phenomena, he believes that there must be some instinct to account for it, and he never fails to find one appropriate. Strangely enough, McDougall severely criticizes this kind of procedure, giving as an example the statement made by V. Cousin as the fundamental assumption of his philosophy of history. This statement is as follows: "The various manifestations and phases of social life are all traced back to tendencies of human nature from which they spring, from five fundamental wants, each of which has corresponding to it a general idea. The idea of the useful gives rise to mathematical and physical science, industry and political economy; the idea of the just to civil society, the State, and jurisprudence; the idea of the beautiful to art; the idea of God to religion and worship; and the idea of truth in itself, in its highest degree and under its purest form, to philosophy. These ideas are argued to be simple and indecomposable, to co-exist in every mind, to constitute the whole foundation of humanity, and to follow in the order mentioned." McDougall then adds: "We have here the spectacle of a philosopher, who exerted a great influence on the thought of his own country, and who rightly conceived the relation of psychology to the social sciences, but who, in the absence of any adequate psychology, contents himself with concocting on the spur of the moment the most flimsy substitute for it in the form of these five assumptions."[27] McDougall's criticism is just. He himself has the advantage of a knowledge of comparative psychology, and hence has been able to identify man with the brute. This always creates a presumption in favor of the profundity of an analysis. However, as far as scientific coherence is concerned, McDougall's presentation may seem as fanciful to future psychologists as Cousin's statement does to present day philosophers. The criticism which Titchener makes of McDougalls' pro-

[26] *Integrative Action of the Nervous System*, 265 f.
[27] *Op. cit.*, 12 f.

cedure is applicable here. He says that the list of instincts which McDougall presents is "a matter of individual preference rather than of scientific finality."[28] Titchener's criticism points out the root-fallacy in McDougall's work. The very nature of the situation is such as to make a scientific formulation of instinctive emotions impossible. And if it is impossible to distinguish the separate instincts and "driving" emotions, it is futile to attempt to trace to them the particular facts and values which now confront us. This is the more true because, as McDougall himself says,[29] the emotional centers, through their cognitive receptors, can come to enforce almost any particular motor expression or fact. Taking into consideration, therefore, the difficulties mentioned above, it is impossible to see to what practical result McDougall's list of instincts can lead. McDougall's confessed purpose is to make a contribution to the Social Sciences by analyzing the dynamic and determinative factors in human nature. However, he has left us with a mosaic of facts which are connected only in a schematic way. Beginning with a handful of supposedly specific, but in actuality hopelessly vague causes, he has left us with an infinitude of results, all obvious but all more or less irrelevant.

However, McDougall's analysis is admirable in its attempt to account for the dynamic nature of instinct by means of emotive forces. No matter what view is held about the number and kind of the emotions, the general opinion is that they are, as the word suggests, moving forces, "contributing not a little to the energy of behavior" (Morgan). Granting, for the time being, that there is a determinate number of instinct-emotions, and that they are the core around which all subsequent modifications and growth take place, we are led to ask: How, or by what principle, do these emotions combine to form the various purposes and values which we possess? How, in the event of a conflict between the various emotions, is the conflict resolved? Or, if the various emotions give rise to various values, all more or less independent, what will be the criterion of the 'relative' value of the desires which these emotions reinforce? McDougall states this problem and explains it by saying: "In the absence of sentiments our emotional life would be a mere chaos, without order, consistency, or continuity of any kind; and all our social relations and conduct, being based on the emotions and impulses, would be correspondingly chaotic, unpredictable, and unstable. It is

[28] *Textbook of Psychology*, 480.
[29] *Op. cit.*, 34 f.

only through the systematic organization of the emotional dispositions into sentiments that the volitional control of the immediate promptings of the emotions is rendered possible. Again, our judgment of values and of merit is rooted in our sentiments; and our moral principles have the same source, for they are formed by our judgments of moral values."[80] The problem which is vital to the discussion and which McDougall names only to ignore is this: How are the emotions organized into a system which shall thenceforth determine the manner in which those emotions shall express themselves? In answer to this question, we must say that in so far as McDougall regards the emotions as fixed and fundamental forces, he has made it impossible for them to create a principle by which they shall be subordinated. On the other hand, in so far as he admits that the instincts are subordinated and harmonized by some other force, or by other causes, he has introduced a principle which is in direct contradiction to his definition of the instincts.

The existence of some factors other than the particular emotions themselves, which determines how they shall express themselves, is generally recognized. It shows itself in the tendency, on the one hand, to analyze each emotion into elements more and more discrete and minute, namely, into sensation qualities; and, on the other hand, to reduce the separate emotions to two or three comprehensive emotions. All such explanations, whether they assume as fundamental a few general emotions, or analyze the general emotions into minute elements, show the same difficulty, namely, the impossibility of explaining the unity of the emotions in terms of units which, by definition, are discrete.

In pleasantness and unpleasantness, however, we have two factors which, in a sense, unify the various emotions by giving them a common character. All emotions are affectively characterized by pleasure or unpleasantness, and it is this common element which determines the direction of the emotion. It is often said that pleasure and unpleasantness serve to guide the emotions, rather than actively to direct or determine them. What it means to guide rather than to direct activity may be decided by those who insist that the man behind a flock of sheep is directing and driving the flock while the men on either side are merely guiding them. It is also very commonly held that pleasure and its opposite are merely signs indicating that the body is functioning normally or abnormally. This is to liken them to sign-posts or to static symbols between which

[80] *Social Psychology*, 159 f.

the emotions proceed upon their path. It is impossible to interpret the affective processes in this negative fashion without destroying their real significance. The reason, probably, why the affective aspect of consciousness has come to be regarded as merely a "guide" is because it is usually diffuse and is concomitant with almost every conscious state. This, however, is not a good reason for depriving feeling of its dynamic significance. If we regard the emotions as dynamic, we must also regard pleasure and unpleasantness as dynamic. In fact, it is quite likely that pleasure and unpleasantness are more fundamental than the emotions, and that not only genetically but actually. The experiments which Goltz performed on dogs, for example, showed that the most persistent and durable reactions were those induced by a stimulus calculated to produce pleasure or pain.[31] Genetically, it is likely that the emotions were subsequent to the more general affective process of pleasure and unpleasantness. However, we must take one more step and ask: What determines the nature of the affective response, whether it be pleasurable or the opposite? Is it some single emotion? Hardly, because then the word as we have been using it would become meaningless. An emotion which determines all other emotions could certainly not be an emotion in the sense in which we have been using the word. The text-books answer this question by saying in several ways the same thing, namely, that when the organism is getting along well or functioning normally, the pleasurable state predominates; while, when the organism is getting along poorly, the unpleasant state predominates. But what does this imply? It implies that there is an organism which has a normal course, a positive and dynamic character of some kind, or possibly a purpose; and when this normal course, whatever it may be, is thwarted, displeasure ensues. When it proceeds normally, pleasure ensues. That is to say, no particular emotion and no particular feeling is the fundamental dynamic factor in life.

Conclusions

The classical concepts of emotion and instinct, represented in the controversies which center around the James-Lange theory, are a hindrance rather than a help to future studies in this field. By regarding emotion as a psychical phenomenon, and instincts as the bodily changes which characterize the emotion, it is made absolutely impossible to establish any causal identity, or even a schematic identity, between the two.

[31] *Integrative Action of the Nervous System*, 266.

Valuable objective studies, such as those of Goltz with dogs, are only made confusing by attempts to interpret into the bodily reactions the emotions which introspection has named. Therefore, the ambitious attempts on the part of some writers to identify instinctive responses with a group of emotions arbitrarily selected is open to serious criticism. And when the entire range of individual and social phenomena is attributed to such a group of uncertain causes, only the most fanciful and uncritical imagination can follow the process by which it is done. But even if we admit the validity of the assumption upon which such a superstructure rests, there is another logical difficulty which we encounter. If we assume, as does McDougall, that the emotions are the fundamental forces in the organism, and that these emotions are fixed in character, it becomes logically impossible to explain the process by which these conflicting forces are unified. How can independent forces give rise to a working principle or "sentiment" which is more powerful than the fundamental forces themselves? This difficulty is recognized in those views which seek to interpret all emotion in terms of the affective processes of pleasantness and unpleasantness. But the analysis of pleasantness and unpleasantness leads us again to the conclusion that even these affective processes derive their significance from some positive content of the organism itself, a content which the current theories of instinct and emotion have not yet exhausted. Whether or not we are able to give to this content any objective meaning is highly problematical. Our present purpose has rather been to point out certain contradictions and absurdities which characterize present thinking in this field, and particularly to call attention to the highly speculative character of the concoctions in which instinct-emotions are used as the prime ingredients.[32]

[32] Save for the paragraph on Watson's view, this paper was written some time before the appearance of Kantor's *A Functional Interpretation of Human Instincts* (*Psych. Rev.*, xxvii, 1920, 50ff.). With slight differences, the writer is in substantial accord with the conclusions reached by Kantor. Indeed, the similarity of the criticisms of McDougall is striking. Kantor, however, has succeeded the better in giving consistent expression to the functional point of view. The writer hopes soon to present his own conclusions in more comprehensive form.

STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF VASSAR COLLEGE.

XLI. The Relation of the Pleasantness of Color Combinations to that of the Colors Seen Singly

By M. F. Washburn, Dorothy Haight, and Jeanette Regensburg.

Professor Geissler contributed to the Titchener Commemorative Volume a study of the affective tone of color combinations, the most positive result of which was to show that "the greater the pleasantness of the individual constituents, the greater will be the pleasantness of the combination." The materials used were the following saturated Bradley colors; red, orange, yellow, green, blue-green, blue, and purple. These were shown in areas of 5 cm. a side, placed side by side to make a strip 10 cm. wide. When single colors were to be judged, the left half of this strip was covered. The background was grey. The method was that of Paired Comparison; one color combination, or one single color, being shown 5 cm. above the other.

The design of our own experiments was to see whether the principle that the pleasantness of a color combination varies directly as that of its components would hold good when absolute rather than comparative judgments of affective value were made, and in general to see what light could be thrown on the problem by altering the method. Instead of the Method of Paired Comparison, we used the one which has been so often employed in our laboratory, that of presenting a single impression, either a color combination or a single color, and asking the observer to express his judgment of its pleasantness by using the number 1 to mean 'very unpleasant,' 2 'moderately unpleasant,' 3 'slightly unpleasant,' 4 'indifferent,' 5 'slightly pleasant,' 6 'moderately pleasant,' and 7 'very pleasant.' Another important difference between our method and Geissler's lay in our *use of shades and tints as well as saturated colors.* We used twelve saturated colors of the Bradley series, twenty-four shades, and twenty-eight tints. The colors were pieces 3 cm. square, pasted on white cards 2½ by 3 inches. Where color combinations were used, two of these squares were pasted side by side on the same card. Each of the two experimenters used a different set of colors, comprising thirty-two of the sixty-four single colors, which were shown and judged first, and sixteen combinations of these colors, which were shown and judged later in the same sitting. There were thus in all thirty-two combinations used. The number of observers, all women college students, was 105 for one experimenter, 106 for the other.

The relation between the pleasantness of the combinations and that of the single colors was found in the following way. The total affective value of every color, when shown alone, was determined by adding the numbers by which the observers expressed their

judgments of its pleasantness; the sum, of course, would be larger, the pleasanter the color was found by the observers as a group. Then the sums thus obtained for each of two colors that were shown in combination were added; the combined sum represented the combined affective value of these colors when they were shown singly. This being done for each of the pairs of colors, it was possible to arrange them in an order representing their pleasantness as determined solely by their appearance singly. Then the numbers which represented the affective judgments of the observers on the combinations as such were added, and the combinations arranged in the order of the size of these sums. Evidently the rank difference correlation between these two arrays will give the degree of relationship between the pleasantness of a color combination and the individual pleasantness of its component colors. This correlation proved to be plus .747, with a P.E. of .0119. It is clear that to a very considerable extent, the pleasantness of a color combination depends upon the pleasantness of the individual colors.

But this fact can hardly be taken, as Professor Geissler seems to take it, for a manifestation of the simple summation of feelings. If the agreeableness of a color combination is due to summation of the agreeableness of its components, or its disagreeableness to summation of the disagreeableness of its components, then a combination of two pleasant colors should be pleasanter than either of the components when seen singly; and a combination of two unpleasant colors should be unpleasanter than either of the components seen singly. This follows from the orthodox doctrine of the simplicity of feeling tones. Now in the entire series of our experiments, in which thirty-two combinations were used, with over a hundred observers judging each combination, there were 861 cases where the component colors, when judged singly, were both found agreeable. In 263 of these cases, or 30.5%, the combinations of these colors were found positively disagreeable. There were 465 cases where the component colors, judged separately, were both found disagreeable; of these 72, or 15.4%, were agreeable in combinations. These figures support the conclusion to which ordinary experience points, that *the unpleasantness or pleasantness of a color combination is derived not merely from summation of the affective tones of its components, but from another factor dependent on the combination itself.* Our results suggest also that this factor more often gives rise to unpleasantness than to pleasantness; that it is easier to get an ugly combination out of two pleasing colors than a pleasing combination out of two disagreeable colors. It may, however, be true that our thirty-two combinations happened to include more cases where the combination factor operated to produce unpleasantness. The relation of the two factors, that derived from the component colors which is responsible for our correlation of plus 74, and that derived from the combination, may be conjectured to depend on whether attention is attracted to the colors as separate colors, when they appear in the combination, or to the total effect.

BOOK REVIEWS

Lehrbuch der experimentellen Psychologie. By J. Fröbes, S.J. Herdersche Verlagshandlung, Freiburg. Bd. I, 1917, 605 pp.; Bd. II, 1920, 704 pp.

The first impression that one gets from this book is an impression of exceptional bulk; a royal octavo of 1,300 pages closely printed in large and small type, and with relatively few figures! The second impression is that of a wealth of citations from other works: the *Autorenverzeichnis* contains over 1,300 names (300 more than the fifth edition of Wundt's *Grundzüge*); and the author assures us, in the preface, that with very few exceptions he has quoted no book or monograph which he has not read through and judged for himself. Moreover, some of the writers are cited not once only, but many times; Wundt and G. E. Müller over a hundred, Fechner forty-six times; between these extremes come in descending order of frequency Lehmann, Meumann, Ebbinghaus, Titchener, Ribot, Stern and James, and Helmholtz. Our author has evidently not only read diligently, but has also chosen wisely. It was his aim, as he tells us again in the preface, to write a text-book of Psychology of the order of Tigerstedt's *Lehrbuch der Psychologie* or of Ebbinghaus' *Psychologie*. Furthermore, the book is designed to serve as an introduction not only to experimental psychology, as the title might lead us to suppose, but also to the other branches of psychology. Finally, the writer says that he has not found it necessary to give in the present book an exposition of his psychological faith. This he hopes to do in another place at some future time; in the meanwhile, the reader who is curious to know more on the point may find views similar to his own in Geyser's *Lehrbuch der allgemeinen Psychologie.*

The first volume of Fröbes' book is devoted to what he regards as the elementary psychological processes. It comprises a short introduction; two long sections, the one on sensation and feeling, the other on perception; and two shorter sections on psychophysics and on the association of ideas. The second volume is concerned with the 'higher mental activities.' It begins with a transitional section on cortical localization and derangement of associations. Then follow four long sections on *intellectual processes* (attention, the self, memory and learning, intelligence, creative imagination, and language); on *emotion* (emotion in general, classification of emotions, the aesthetic feelings, and expressive movements); on *will* (movement and reaction, the will-consciousness, custom and religion, and personality and mental development); and finally on *anomalies of consciousness* (sleep and dreams, hypnotism and suggestion, and mental pathology in general). Under some of these chapter-headings are materials of differential psychology, social psychology, educational psychology, juristic psychology and the psychology of aesthetics. An enormous programme! What does the author make of it?

He defines experimental psychology as the "science of mental processes, their laws, and their connection, as based upon observation and experiment." By the term 'mental processes' he means psychical

phenomena or phenomena of consciousness, the objects of inner experience. He dismisses definitions by point of view (of which he refers to Wundt's as an instance) solely by the assertion that physics and psychology have no objects in common. The problem of psychology is the description and explanation of the phenomena of consciousness; explanation, of sensation at least, is to be found in physical objects and their effect upon the nervous system. All this is said in the most summary fashion. Fröbes devotes, however, nine pages to method. He recognizes as methods of psychology introspection and observation of behavior (*Fremdbeobachtung*). His treatment of the former is mainly an abstract of the views of G. E. Müller; concerning the latter he follows in the main W. Stern. His notion of sensation is reminiscent of James, Höfler and Geyser: sensations are the elements of the more objective processes, the *Erkenntnisvorgänge;* they are items of knowledge of attributes which belong not to the knowing subject but to the sensory describable object; they combine to form perceptions; and they are also the elements which, at still higher stages, give rise to conceptions and judgments. Every sensation has four attributes, quality, intensity, temporal duration and spatial extension; the two latter, however, do not in Fröbes' thinking belong to sensation in the narrow sense; they are rather 'formal elements,' which assist in the formation of perceptions. Simple feelings, on the other hand, he regards as the elements of the 'more subjective processes' like Emotion and Will. They are dependent upon sensations, but are differentiated from them principally by virtue of their subjectivity. Fröbes also recognizes simple and complex ideas (*Vorstellungen*); the former he considers as 'renewals' (*Erneuerungen*) of earlier simple sensations; the latter are complexes of simple ideas, as perceptions are complexes of simple sensations. Although he discusses differences in intensity, in activity, in direction of attention (Fechner), and Müller's 'indistinctness' of normal images, as marks of differentiation between sensation and simple idea, he concludes that no one of them is essential. In all these systematic questions, however, one feels that the author is not seriously interested; the definitions seem to be merely introductory, purely formal, and are given as if they were to be expected and must be got out of the way. Moreover, the simpler processes are not inherently necessary to the higher. Attention is, for example, placed among the higher intellectual processes, of which sensations are by definition the elements; yet attention suddenly appears full-blown as clearness of higher processes; it is characterised as the opposite of distraction, of wool-gathering, and as subjective (not the objective clearness or distinctness of objects); after this characterisation the literature of attention is discussed under the familiar rubrics; and that is the end of attention. Again, when we come to emotion, the higher feelings are differentiated from the lower by difference in temporal course, in ease of inhibition, in dependence upon mental conditions, etc.; but the question how the simple combine into the higher feelings is never even raised. This lack of interest in writing a psychology that is systematic in any sense other than that of mere classification along conventional lines occasionally leads our author to unfortunate results. Among these is a failure at times to understand clearly the systematic views of other writers. For example, in his discussion of the attributes of sensation he says: "Titchener replaces the attribute of extent (*Räumlichkeit*) by that of clearness, which is determined by the strength of attention" (I, 28). Another result

is a confusion in classification. For instance, the section on thought (in which the Würzburg and the Cornell studies, Wundt's reaction against the thought-experiments, Koffka's book, etc., are reported) divides the chapter on perception into two parts; it occurs after the detailed accounts of the perceptions of space, time and movement, and before those of synaesthesia and the perception of form. The author gives no reason for this grouping; and whatever we may guess leads to the conclusion that the problem of perception has never been fully realized. What, then, it may be asked, is the author's positive contribution to our science?

The book is a collection of facts on and about psychology, drawn from a large number of different sources; the results of experiments conceived from various points of view, selected according to the compiler's judgment, classified under the usual chapter-headings, and moulded into readable form. The attempt is unique in psychology; the nearest approach, Myers' *Text-book of Experimental Psychology*, is still very different. The positive value of the book depends, therefore, upon the relative value of the facts selected, the completeness with which the ground is covered, the accuracy with which the facts are reported, the skill with which they are presented, and the aids supplied for the reader's convenience. From these points of view let us examine the book once more

The section on sensation is, aside from that on association of ideas, the most complete of the entire work. The facts of visual sensation are taken principally from Hering and his pupils, v. Kries, Titchener, Ebbinghaus, and G. E. Müller. Helmholtz and König are, however, not ignored. The chief innovation is the extended incorporation of Müller's views, drawn not only from the well-known *Zeitschrift* articles but also from Fröbes' manuscript notes of Müller's lectures taken in 1903. The chapter on auditory sensation is based upon Stumpf, Helmholtz, and Schäfer's article in Nagel's *Handbuch*. Two pages are given to Révész' *Qualität*; and in the paragraph on *Klangfarbe* there is a report of the vowel-controversy, which includes the work of Köhler and of Jaensch; the solution of both these problems is, however, left to the future. The principal omission is that of tonal volume, which is mentioned only as a 'quantitative element' of *Klangfarbe*. On the side of theory we have only a brief account of Helmholtz', and a still shorter reference to that of Ewald; for others the reader is referred to Schäfer. Taste and smell, cutaneous, kinaesthetic and static, and organic sensations are likewise reported from the standard sources, and on the whole are faithfuly reported and clearly presented. Apparently, neither Henning's work on taste and smell nor Boring's on sensations of the alimentary canal was available; but, at any rate, are missing. The account of simple feeling is mainly a summary report first of the controversies about feeling (which suffers for want of insight into the reasons for the differences of opinion), and secondly of the results of experiments by the method of expression, particularly those of Lehmann and the Wundtians. All of the experimental work based upon the method of impression is ignored. The experimental work on 'simple ideas' is also insufficiently reported. In the long section on perception, the principal facts are taken from the important secondary sources like Hermann's and Nagel's *Handbücher*, the treatises of Wundt, Ebbinghaus, Stumpf, Witasek, etc. There are also many reports of original experiments and occasional abstracts of long books. One wonders at times at the relative amount of space assigned to various topics;

why, for instance, six pages should be given to a digest of Katz' *Erscheinungsweisen der Farben*, significant as that book is, and only about the same amount to the geometrical-optical illusions. Or again, one may miss a fact like Wertheimer's Phi-phenomenon which seems important enough for mention. On the whole, however, the section is well done. The point of view of the *Psychophysik* is that of Müller; and the treatment of methods, and discussions of the significance of the limen, of Weber's law, etc., are drawn principally from Fechner, Müller, Titchener, and Lehmann. The article is, however, brought up to date; the views of Wirth and Urban are presented; and the section closes with a long chapter on correlation. The best parts of the final section of the first volume, on association of ideas, are, as one might expect from a pupil of Müller's, those which deal with the methods and results of the association-experiments. The worst part is the chapter on ideational types, which is inadequate as regards the available facts. The association-reaction, including Jung's *Tatbestandsdiagnostik*, is described in this section.

This brief analysis of the first volume must suffice for the present review, although the second volume is a different book, and might well have had a different title; it is a 'general' psychology. And because under many chapter-headings there is no large body of accepted fact upon which to draw, there is greater opportunity for disagreement as regards the choice of the facts which go into these chapters. The author has, however, in most cases chosen his authorities wisely: Meumann and Müller for memory and learning, Wundt for language, Ach for will, Fechner, Groos, Witasek and Külpe for aesthetics, Stern for differential psychology, Preyer and Stern for child psychology, Kraepelin, Störring and Janet for abnormal psychology. If no one of the chapters based on such authorities would fully satisfy the expert, they will at least give the reader an orientation, not in the points of view of the various psychologists, but in the principal facts. And this, we suppose, is the author's aim. It must, however, be added that arrangement and emphasis often leave much to be desired: let the reader try, for instance, to determine from Fröbes' references the various usages and the preferred signification of the important term 'empathy'!

Taking the book as a whole, and overlooking minor errors and omissions, we must judge it as a well-selected compendium of the facts of psychology. So far as our reading has gone, we have found the reports of the principal facts reliable; the author is not so trustworthy in reciting controversies or in expounding systematic views because he has not taken the trouble to go beneath the controversies or sympathetically to understand systematic differences. He has, as he planned, written a book of the order of Tigerstedt's *Physiologie*, but he has not approached (as he also desired) Ebbinghaus' *Psychologie*. For Ebbinghaus had a point of view which he tried to drive through the *Grundzüge;* and however inadequate he may at times have been, he always had an insight which penetrated to the psychological significance of his facts, and he was at all times critical, keenly discriminative, and constructive. Fröbes, on the other hand, is a reporter who has read widely and painstakingly, but from the outside; if he attempts criticism, he is likely to be superficial; if he is discriminative, it is seen only in his selection of facts for treatment and not in his treatment of the facts; and, lastly, he is never constructive; he throws no new light upon old facts, opens no novel perspective, makes no new generalization.

H. P. W.

Vorlesungen über die Menschen- und Tierseele. By W. WUNDT. Sechste neubearbeitete Auflage mit 53 Figuren im Text. Leipzig, L. Voss, 1919. pp. xvi, 579. Price (at time of publication) Mk. 26.

This book has had an amazing career. It began in 1863 as a two-volume work whose programme was nothing less than the rounding-off of all departments of psychology, experimental, animal, social, into a systematic whole. Since in those early days Wundt had not learned to distinguish between psychology and applied logic,—he soon came to the discovery, and he never tired of proclaiming it,—there is no reason to wonder that his attempt was a failure. Critics declared, and the Wundt of 1906 is not unwilling to agree, that the book so far from inaugurating a reformation in psychology, was merely an immature and misdirected essay.

In course of time, nevertheless, the edition was exhausted; and in the late eighties the original publisher came to Wundt with the suggestion of a new issue. Wundt hesitated for some time, but finally acceded to the request. There was, he thought, a certain amount of the old matter that might still stand, and there was a vigor and freshness of style that he might not easily recover. The book was, also, something of an incubus; the printed word, however emphatically he should elsewhere renounce his change of view, bound him to statements that he would gladly revoke; and a new edition would formally supersede the earlier work. So a single volume appeared, as a second edition, in 1892. The logical framework was discarded; the lectures on social psychology were excluded; the whole text was rearranged and recast. This is the edition that Creighton and I translated in 1894—the first of Wundt's books to be published in English.

A third German edition was called for in 1897, and a fourth in 1906. The fourth edition is remarkable on the ground that Wundt here tried, for the first time, to do rough justice to the modern developments of animal psychology. The incident is eminently characteristic: Wundt, who knew nothing at first hand of the lower forms of life save what he had learned—how many years before!—in the zootomic laboratory of Johannes Müller, and who knew nothing at first hand of the higher forms save what he had learned by intercourse with the domestic cat and dog, undertakes at the age of seventy-four to review the 'literature' of animal psychology, to pass critical judgment upon it in the light of human psychology, to bring out the fundamental questions of principle, to show connections, to mark lacunae, all for the sake of three or four chapters of a popular book. It is needless to say that these chapters, and the preface that goes with them, inadequate as they must appear to the professional student of animal behavior, are nevertheless of high value to psychologists at large; they give us animal psychology in the Wundtian setting; they show us the relation in which Wundt placed animal psychology to individual human psychology no less clearly than the encyclopaedic *Völkerpsychologie* shows the relation of social psychology to the same central discipline.

The new chapters were popular; a fifth edition came out in 1911; and a sixth and final edition—let us hope that no editor rises up to lay hands upon it—in 1919. There is little that is new in this last revision: a note that brings the physical theory of relativity into connection with the psychological is, perhaps, the most important addition; all changes are minor. The book remains what it was in 1892, "a pretty mixed medley of new and old," but a medley so

cunningly mixed that the layman will never suspect the diversity of origin, and a medley so various that the psychologist may find in it an epitome of the history of modern psychology. It is a long stretch from 1858 to 1919, a long stretch especially in the history of a young and rapidly growing science. Wundt has been able, as no one else can ever be, to compress a vast deal of this history, for the benefit of those who read with understanding, into the limits of a single volume.

E. B. T.

Fugitive Essays. By J. Royce. With an Introduction by J. Loewenberg. Cambridge, Harvard University Press, 1920. 429 pp.

Here are printed fifteen of Royce's essays. All of those previously published were virtually inaccessible; all but three belong to the period 1878-1882; and four appear in print for the first time—"The Practical Significance of Pessimism" (1879), "Tests of Right and Wrong" (1880), "On Purpose in Thought" (1880), and "Natural Rights and Spinoza's Essay on Liberty" (1880). The editor contributes an illuminating introduction (37 pp.), in which he emphasises the continuity of Royce's earlier and later work. The volume contains a good portrait of Royce; it should have had an index.

Collected Essays and Reviews. By W. James. New York, Longmans, Green & Co., 1920. pp. x (Preface by R. B. Perry), 516.
Annotated Bibliography of the Writings of William James. By R. B. Perry. New York, Longmans, Green & Co., 1920. pp. ii, 69.

All psychologists will be grateful to Professor Perry for the labor of love that he has spent on these two books. The first contains thirty-nine scattered articles and reviews written by the late Professor James between the years 1869 and 1910. They include the "Remarks on Spencer's Definition of Mind as Correspondence" (1878), "The Sentiment of Rationality" (1879), "What is an Emotion?" (1884), "The Original Datum of Space-Consciousness" (1893), and many another classical paper. The Bibliography, based upon James' and Holt's List of 1911, comprises (if a hurried counting may be trusted) 311 titles, arranged chronologically from 1867 to 1920. Most of the titles receive brief comment, and an alphabetical index is appended.

Social Scandinavia in the Viking Age. By Mary W. Williams. New York, The Macmillan Co., 1920. pp. xiv, 451, with 50 illustrations and map. Price $6.00.

This is an interesting and scholarly book—undoubtedly the best introduction to its subject that we have in English. It meets fairly the charge of our childhood's histories that the Northman, admirable in courage, was at the same time drunken and licentious, an inveterate gambler, a violator of his oath. After an introductory sketch of the land and the people, the chapters take up in order the ties of kinship and nationality; the classes of society; infancy, childhood and youth, dress, ornament, personal refinement; marriage and divorce; the position of women; homesteads and houses; house-furnishings and food; agriculture and the routine of farm life; hunting, fowling, fishing; internal travel. ships and nautical science; trade and commerce; markets and towns; the career of the Viking; his weapons and warfare; government; system of justice; social gatherings, recrea-

tions, amusements; language and literature, the runes; learning in general; scientific knowledge, art; objects of worship; places and methods of worship; superstition; death and burial. The illustrations are well chosen, and the book ends with a useful bibliography and a full index.

The Philosophy of Don Hasdai Crescas. By M. WAXMAN. New York, Columbia University Press, 1920. pp. xii, 162. Price $1.75 net.

Hasdai Crescas, the last of the Jewish mediaeval thinkers, was born of a noble and wealthy Catalonian family in 1340, lived the greater part of his life at Barcelona, and died at Saragossa in 1410. He wrote a work entitled "The Light of God," in which among other things he criticised Maimonides' proofs of the existence of God, and his views of the divine attributes and of the relation of God to the world, and set forth his own positive convictions. In the present study Dr. Waxman expounds the system of Crescas, whom he exhibits as an intellectual rebel against Aristotle, a probable influence upon Spinoza, an analyst surpassing Maimonides himself. The Introduction deals with Jewish and Arabic philosophy at large, with the treatment of the problem of the existence of God in pre-Maimonidean Jewish philosophy, and with the theology of Aristotle. Part I then discusses the problem of God, his existence, essence, unity, attributes; and Part II the relation of God to man, as exemplified in the questions of free-will and determinism, providence, immortality. The study concludes with bibliography and index.

The following books have been received:

L. KLAGES. *Vom Wesen des Bewusstseins, aus einer lebenswissenschaftlichen Vorlesung.* Leipzig, J. A. Barth, 1921. Pp. vi, 94. Price Mk. 12.

G HEYMANS. *Einführung in die Metaphysik auf Grundlage der Erfahrung.* Dritte durchgesehene und vermehrte Auflage. Leipzig, J. A. Barth, 1921. Pp. vi, 364. Price Mk. 56.

F. WELTSCH. *Gnade und Freiheit.* München, Kurt Wolff Verlag, 1920. 157 pp.

J. B. PRATT. *The Religious Consciousness, a Psychological Study.* New York, The Macmillan Co., 1920. Pp. x, 486.

E. GALLI. *Alle Radici della Morale.* Roma, "Unitas," 1919. 415 pp.

E. GALLI. *Nel Domino dell' "Io."* Roma, "Unitas," 1919. 205 pp.

NOTES

Wilhelm Wundt died at Leipzig on the afternoon of Tuesday, August 31, 1920, a fortnight after the celebration of his eighty-eighth birthday. Psychologists of all interests and of all shades of opinion unite to do homage to the memory of the foremost representative of their science. We hope in a later number to print a sketch of Wundt's life and psychological work.

Théodore Flournoy, who held the chair of psychology and history and philosophy of science at the University of Geneva, died on Nov. 5, 1920, at the age of 66. Flournoy published in 1893 a volume on *Des phénomènes de synopsie,* and became widely known by his *Des Indes à la planète Mars: étude sur un cas de somnambulisme avec glossolalie,* 1900 (translated into English in the same year). He published also: *Le génie religieux,* 1904; *La philosophie de William James,* 1911 (translated 1917); *Esprits et mediums,* 1911 (English abridgment, *Spiritism and Psychology*); *Une mystique moderne,* in Arch. de psychol., xv, 1915; *Mètaphysique et psychologie,* 1919 (reprint, with preface by H. Höffding, of the edition of 1890); and many other studies in the *Archives* and elsewhere. He was co-editor with Professor Claparède of the *Archives de psychologie* since the foundation of that journal in 1902.

Alexius von Meinong, professor of philosophy in the University of Graz, died on Nov. 27, 1920, at the age of 67. Meinong is best known by his contributions to the border-discipline which he named *Gegenstandstheorie*; his *Gesammelte Abhandlungen* were published in three volumes in 1913-14. His doctrine of supposals (*Ueber Annahmen,* 1902, 1910) attracted widespread attention. Meinong also wrote on topics of direct interest to experimental psychology (Weber's law, the color-pyramid, etc.), and in 1894 founded at Graz the first Austrian laboratory, from which has come a long and valuable series of experimental studies. He was strongly influenced by Franz Brentano, but with his friend Alois Höfler arrived at conclusions which Brentano vigorously combatted; indeed, we owe to Meinong much of the new matter in Brentano's *Von der Klassifikation der psychischen Phänomene* (1911).

Elmer Ernest Southard, professor of neuropathology in the Harvard Medical School, from 1912 to 1919 director of the psychopathic department of the Boston State Hospital, and in 1919 appointed director of the Massachusetts State Psychiatric Institute, died Feb. 8, 1920, at the age of 44. The Bulletin of the Massachusetts Department of Mental Diseases, iv, no. 1, Feb., 1920, which is issued as a Southard Memorial number, contains a characteristic portrait, an appreciation by Dr. R. C. Cabot, and a bibliography.

SYSTEMATIC PSYCHOLOGY

Professor Stumpf has recently published in the Memoirs of the Prussian Academy of Sciences, and also as separate works, two important monographs in systematic psychology.[1] (1) The first (1917) deals with the attributes of visual sensations. Aside from spatial and temporal characters, which he does not consider, Stumpf recognises three attributes: quality, brightness, and intensity. The change which differentiates the progression of blue-red-yellow from the progression black-grey-white is a change of quality; the change which is common to the two progressions is a change of brightness. The achromatic series thus shows, like the color series, changes both of quality and of brightness. Intensity, the outstanding difficulty of the psychology of visual sensation, receives thorough discussion. Stumpf frankly accepts the attribute, on the analogy of the other senses, and seeks evidence for it. He finds in the grey (which, in popular speech, is a dark grey) of the resting eye—G. E. Müller's middle grey, Révész's critical grey—the weakest visual sensation, and in direct sunlight the strongest. Theoretically, all the visual qualities, including of course the blacks which are darker than the critical grey, lie in a single straight line of intensity between these terminal points. As a matter of fact, the qualities that we see in ordinary diffuse daylight are of approximately constant intensity. If, however, we observe strongly illuminated (especially yellow) surfaces on a dark background we may note definite intensive changes: the yellow, *e. g.*, remains the same yellow, but as the illumination increases becomes yellower, not in the sense of greater saturation, but in the intensive sense of more strongly yellow. These observations, Stumpf argues, are sufficient to establish the attribute of intensity: colateral evidence is found in the experiments upon color limens.—Saturation or chroma then necessarily disappears as a visual attribute. Stumpf declines to recognize insistence, and apparently declines to recognize clearness or vividness, though formally he leaves this issue open.

(2) In the second monograph (1918) Stumpf seeks to determine the difference between sensory and imaginal experience, between *Empfindung* and *Vorstellung*. He begins by discussing, with special reference to tones, the criteria currently applied: presence and absence of external causes, specific diversity of contents, specific diversity of acts, gradual difference of intensity. The evidence points decisively to a mere difference of degree. Stumpf accordingly adopts this position, and from it rebuts a number of objections: that, with a merely intensive difference between sensation and image, we could not talk of an imaginal fortissimo; that metric comparisons of the intensity of sensations and images ought to be possible; that images could not be present simultaneously with sensations of the same sense; and that the facts of the limen would be unintelligible. He then turns from hearing to sight, and considers the intensity of visual images, their spatial properties, the phenomena in the neighborhood of the limen, and the separation of colors and greys in ordinary ideas and in hallucinations.

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[1] "Die Attribute der Gesichtsempfindungen," *Abh. d. kgl. preuss. Akad. d. Wiss.*, Jahrgang 1917, phil.-hist. Klasse, no. 8. Einzelausgabe, Berlin, 1917; price (at the time of issue), Mk. 5.25. 88 pp.

"Empfindung und Vorstellung," *Abh.*, etc., Jahrgang 1918, phil.-hist. Klasse, no. 1. Einzelausgabe, Berlin, 1918; price (at time of issue), Mk. 6.75. 116 pp.

The upshot is that all *sinnlich-anschauliche Erscheinungen*, all the 'sensory' and 'imaginal' experiences, of a determinate kind form a single intensive series, ranging continuously from the weakest 'image' to the strongest 'sensation.' From the purely phenomenological point of view there is no reason for a distinction of the two classes. We gradually learn, however, that experiences of a certain range of intensity are usually due to outside causes, and we thus come in course of time to an immediate, unreflective differentiation of perception from idea. Scientifically, the line of division is drawn at the stimulus-limen. But once the dividing line has been drawn, once the scale of intensities has been calibrated, a conscious reference-to-object is unnecessary; henceforth intensities above the limen go by the very fact of their intensive rank to the class of sensations, intensities below the limen to the class of images.

Stumpf proceeds to the enumeration of secondary criteria. *Vorstellungen* are poorer than *Empfindungen* in immanent and concomitant characters; they are fleeting, or at any rate less sharply delimited in duration; they are largely modifiable at will. And, as a result, the affective influence of *Vorstellungen* is on the average less than that of *Empfindungen*; and "if the question of the real significance of the phenomena arises, it is in the case of *Vorstellungen* bound up with the consciousness that the belief in reality needs justification, while in face of *Empfindungen* this belief is, at least for the naive consciousness, immediate."

If all images lie below the intensity of the stimulus-limen, it follows that many experiences which we currently number among images must be renamed sensations; Stumpf devotes a section to subjective sensations and hallucinations. From these he passes to the collateral evidence for the qualitative likeness of sensation and image: associative memory, the fusion of reproduced and perceptive elements in the unitary empirical object, associative reproduction and the recognition of purely imaginal formations, likeness of sensory and motor effects. Finally, he distinguishes between images of memory and images of recollection, but hesitates to recognize a class of images of imagination.—

Whether or not we agree with Stumpf's conclusions, we may be heartily grateful to him for the patient thoroughness with which he has worked them out; and fortunately they may, in most cases, be put to the ultimate test of experiment. The brightness-attribute of visual sensations will, one is disposed to think, find ready acceptance; the intensive attribute will doubtless be disputed, but has at any rate achieved respectability. Saturation may be dispensed with the more easily if one accepts Dimmick's view of grey as not the specific mid-term of a single black-white series and the end-term of chromatic series, but the end-term of six specifically qualitative series. As regards sensation and image, I confess that Stumpf's exaltation of intensity does not so far convince me, and that his account of the observer's behavior in the liminal region does not square with my own experience. I incline rather to a differentiation by 'body,' by collocation of attributes. Here as elsewhere, however, experiment will decide.

E. B. T.

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

The twenty-ninth annual meeting of the American Psychological Association was held at the University of Chicago, December 28, 29, 30, 1920, with approximately one hundred fifty members present. The Sections of Psychology and Education of the American Association for the Advancement of Science met at the same time and in the same building and members of both organizations circulated freely between parallel programs. The fifty-seven papers presented before the American Psychological Association were about equally divided between experimental and general psychology on the one hand and applied psychology and mental tests on the other. After the annual banquet the retiring President, Dr. Franz, gave the presidential address on "Cerebral-Mental Relations," in which he brought together the recent evidence against fixed localization of function in the brain. Messrs. Cattell, Judd, Scott, and Pintner spoke informally in appreciation of Wilhelm Wundt, presenting personal reminiscences of their work with him.

The meetings were marked by considerable discussion of plans of organization in psychology and of the ways and means for meeting the demands which the recent extensions of psychology have placed upon scientific sources of fact and personnel. There was also evidence, as numerous papers attested, of a desire on the part of experimentalists to break down distinctions existing at present between schools of psychology and to emphasize psychological community of thought rather than differences of points of view.

The election of officers resulted as follows: President: Margaret Floy Washburn, Vassar College; Members of the Council, 1921-1923: George F. Arps, Ohio State University; Walter S. Hunter, University of Kansas; Nominees for appointment to the Division of Anthropology and Psychology of the National Research Council: Walter B. Pillsbury, University of Michigan; George M. Stratton, University of California.

E. G. B.

RECOGNITION OF FACES

The prompt and sure identification of persons by recognition of their faces is so obviously a matter of practical importance that it is amazing that it has not earlier become an object of critical and experimental study. Dr. Henning[1] has, however, laid an excellent foundation in analysing the problem and working out a method for a quantitative attack upon it, from which follow in natural sequence a method for the training of those whose business it is to recognise faces, and a new field for testing in vocational guidance. Incidentally he has also supplied psychology with a striking instance of the operation of the "apperceptive mass," and furnished ethnology with a new method of racial classification.

For the details the paper itself must be consulted; but it may be noted that unerring identification of faces is dependent upon the analysis of them, *i. e.*, upon attention to certain primary facial elements (eyes, eye-brows, nose, mouth, etc.) and their variations—

[1] H. Henning, Das Wiedererkennen menschlicher Gesichter in kriminologischer Hinsicht. Mit 14 Abbildungen. *Arch. f. Kriminologie*, 72, August, 1920, pp. 235-254.

inexpert looking at faces is always satisfied with unanalysed total effects—and that the method consists in finding the minimal facial area, determined on a photograph or a real face by means of an Aubert diaphragm or something similar, which permits certain recognition.

The illustrations show the bilateral asymmetry characteristic of most faces and the difficulty of recognising even well-known faces when seen in part only. It is regrettable that the pictures illustrating bilateral asymmetry complicate the matter by introducing a gross and unnecessary difference in the arrangement of the hair.

E. C. S.

A FURTHER WORD ON SUPERSTITIOUSNESS

Since publishing my study of the superstitions of college students (this JOURNAL, 30, 1919, 83), I have discovered a somewhat similar study made over thirty years before and published under the rather misleading title of "First Report of the Committee on Experimental Psychology" (*Proc. of American Society for Psychical Research*, 1, No. 3, 1887). The report is signed by the committee's chairman, Professor C. S. Minot. A form of questionary was used, and the study was designed to "test the prevalence of a tendency to superstition in the community." The three questions in the list upon which the conclusions of the report were based sought the frequency of tendency to superstitiousness concerning the number thirteen, Friday, and seeing the new moon over the left shoulder. Why these three and only these were selected is not made clear. Five hundred returns were tabulated, but no definite statement appears in the report concerning the class of people from whom the returns came, except a vague statement in the concluding paragraph about "the educated portion of our community" and a reference to New England.

This report concludes that 10% of men and 20% of women have a tendency to superstition, and the committee expressed surprise at the large number. My own results indicate a much larger percentage of both men and women (men admitting present belief or practice 40%, and women 66%). Can it be that there has been such an astonishing increase in superstitiousness in thirty years? Probably not. The small figures which the committee obtained are more likely due to the curious limitation of their study to three superstitions. It is true that the committee's returns were from adults chiefly, while mine were entirely from adolescents; but an analysis of their tables indicates that the returns which they included from those of adolescent years present the same small percentages.

Isolation of the committee's returns from adolescents, for comparison with my own returns, indicates that the committee found about 11% of young men with a superstitious tendency and about 17% of young women. My results for the same age-group were 40% and 66%, approximately the same ratio. That two studies made thirty years apart, in localities three thousand miles apart, and by somewhat different methods, should indicate the same degree of difference between the sexes adds much to the reliability of the conclusion.

Neither Dresslar's work nor mine, however, supports the conclusion of the Minot committee that there is a greater tendency to be superstitious about the new moon than about either Friday or the

number thirteen. As our combined work covers so many more cases, it must certainly be that the Minot committee were led astray by a chance result

University of Oregon. EDMUND S. CONKLIN.

COMBINATIONAL TONES REGISTERED BY THE TONOSCOPE

In a recent number of this JOURNAL[1] the writer reports the effectiveness of the tonoscope for registering difference-tones of the first order. Later experiments justify further conclusions.

In this study difference-tones of higher orders were investigated. For this purpose the generators employed were the bugle and the voice. Two points were essential in selecting the range of the generating notes: that their difference-tones should lie within the limits of the tonoscope-readings, or at least not beyond a very small multiple of the readings, and that the various difference-tones should be far enough away from one another and from their generating notes to prevent overlapping and blurring of the dots on the tonoscope. When these precautions were observed, records of difference-tones of the second and third orders were as easily and clearly obtained as those of the first order had been in the earlier experiments.

BUGLE TONE		SINGING TONE		
Approximate note	Tonoscope Readings in vibs.	Approximate note	Tonoscope Readings in vibs.	Tonoscope Readings for Difference Tones in vibs.
a#[1]	$120 \times 4 = 480$	f#[1]	$123 \times 3 = 369$	D_1 $111 \times 1 = 111$
	$160 \times 3 = 480$		$184 \times 2 = 368$	D_2 $129 \times 2 = 258$
				D_3 $147 \times 1 = 147$

Records for summation-tones obtained from these generators were then attempted without success.

Many theories have been advanced regarding the nature and origin of summation-tones. W. Preyer,[2] following a suggestion made by G. Appunn, explains them as differential tones derived from the action of partials rather than from the generating tones themselves. He declares that all cases of summational tones on record might conceivably fit into this theory. This view suggested a means of approach through the tonoscope. If, for example, the summation-tone of 500 vibs. arising from two notes with vibration-rates of 300 and 200 respectively may be regarded, not as the sum of the two generators, but as the difference between the first generator's second partial of 600 vibs. and the first difference-tone of 100 vibs., then generators possessing a strong second partial ought to register this 'summation' tone as easily as difference-tones, and generators lacking the second partial in any strength ought to fail to register this tone although difference-tones be clearly recorded.

To check this supposition trombones were selected because of their strong second partials, and clarinets because this partial is an almost

[1] E. Gough and G. Robison, The Tonoscope as a Means for Registering Combination Tones, *Amer. J. Psychol.*, 31, 1920, 91ff.

[2] H. Helmholtz, Sensations of Tone; Additions by the Translator, A. J. Ellis, 1895, 532.

negligible component of the tone.[3] Difference-tones of the first two orders were attempted with good results from both instruments.[4] The two trombones gave a clear reading of a summation-tone from the following generating notes: f, 176 vibs. and A, 117 vibs. The tonoscope recorded 147×2, or 294 vibs.[5] The clarinets were uniformly unsuccessful in producing readings for summation-tones, although conditions were well adapted for recording them if present.

More delicate and more extensive work needs to be done to investigate this theory further. These experiments tend to support the conception that summation-tones are to be regarded more accurately as difference-tones dependent on the presence of a strong second partial tone.

Smith College. EVELYN GOUGH.

APPOINTMENTS

Dr. Samuel W. Fernberger, recently Assistant Professor of Experimental Psychology at Clark University, has been appointed Assistant Professor of Psychology at the University of Pennsylvania. Mr. C. C. Pratt has been appointed instructor in experimental psychology at Clark University.

Dr. F. L. Wells has left the McLean Hospital, Waverley, Mass., to become head of the Psychological Department at the Psychopathic Hospital, Boston, Mass.

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[3] The writer was exceedingly indebted to the generosity and the patience of Northampton musicians in carrying on this section of the work. Mr. Carl Dodds and Dr. C. E. Perry played the trombones and Miss Myrna Wilderson and Mr. Carl Brand the clarinets.

[4] The clarinet gave good readings only for tones produced by closing most of the keys. Otherwise the air escaped through these openings instead of being directed into the tonoscope. The trombone proved an excellent instrument for this use.

[5] The second partial itself could never be read obviously from the tonoscope.